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Midnight Engineering

Resources And Insight For The Entrepreneurial Engineer

May/June, 1995
Volume 6, Number 3

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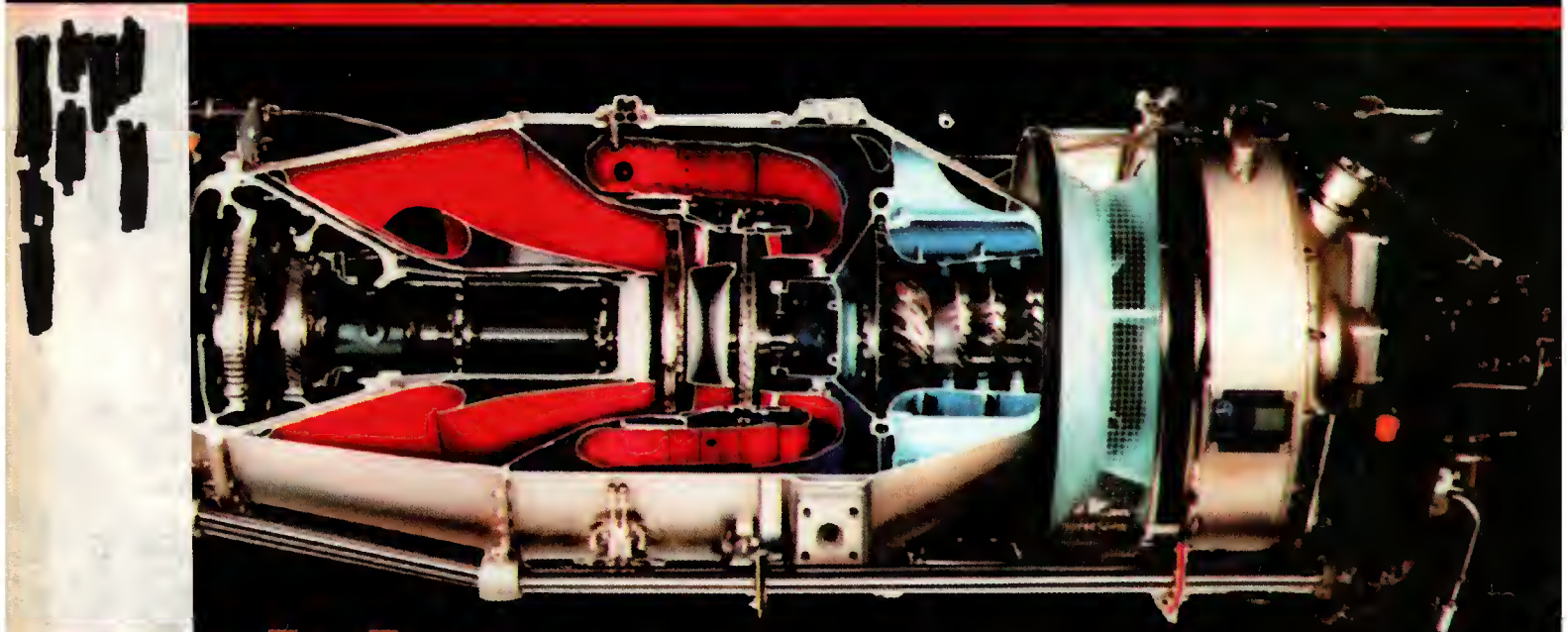

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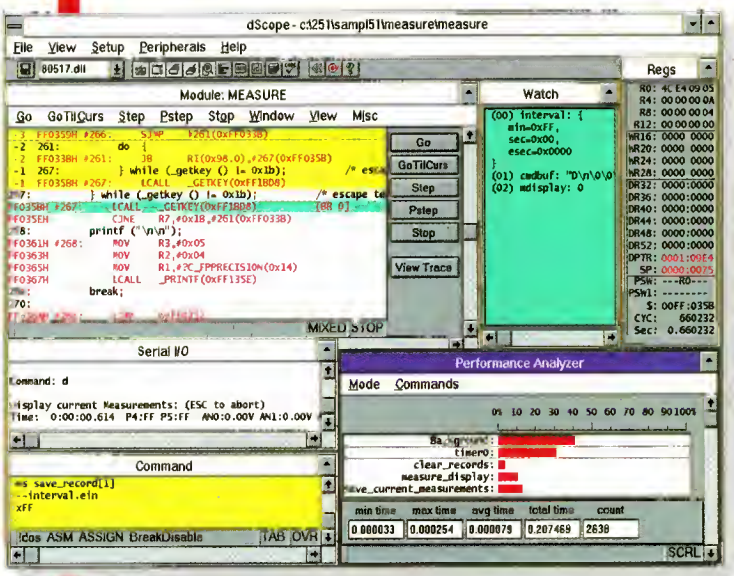

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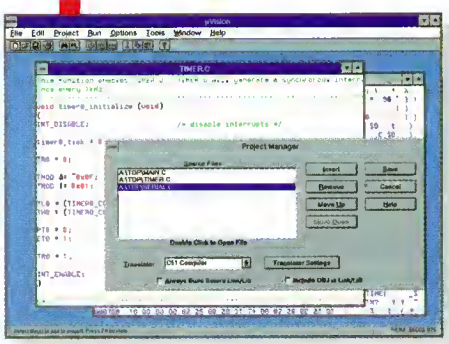

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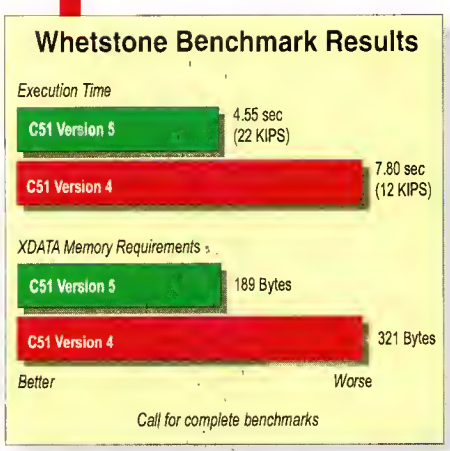

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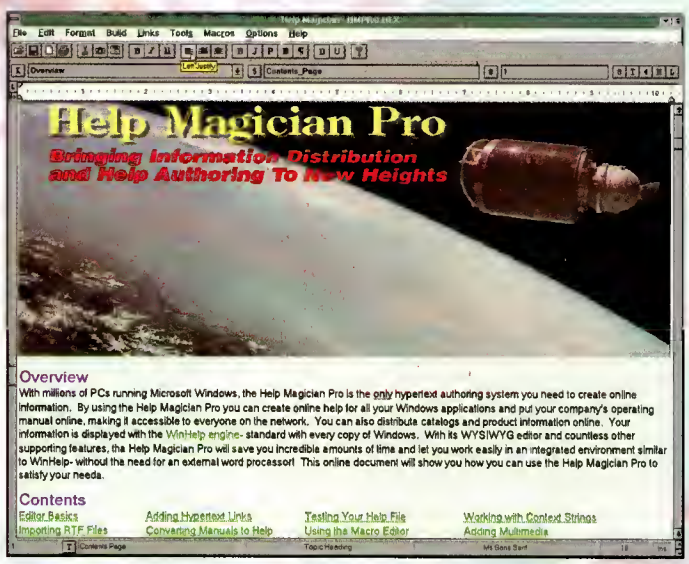

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May/June, 1995
Volume 6, Number 3

Midnight Engineering

Resources and Insight For The Entrepreneurial Engineer

About ME ...

ME is dedicated to those individuals interested in creating, developing, producing, and distributing high technology products. The content is meant to address the individual and small enterprise, their entrepreneurial issues and opportunities, and the technology they use now and will use in the near future. The magazine is designed around the concept of "a half-dozen entrepreneurial engineers sitting around having a beer." Topics will range from embedded systems technical details to software and hardware design. A particular issue might cover biotechnology or nanotechnolygy just as well as everyday personal business such as taxes or time management and productivity. Quite simply, ME reflects the exchange of experience, insight, and concerns of today's entrepreneurial engineer.

This magazine was developed, edited, produced, and published by one person — there is no editorial or production staff involved at any time. The contributors are entrepreneurial engineers and their submissions are not intended to set any literary highwater marks.

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Cover: **Pratt & Whitney PT6 in use worldwide on aircraft and industrial applications such as auxiliary power, pumping stations, marine propulsion, and electrical generators. Contrast the PT6 with a pair of SR-30s from Turbine Technologies mounted on a BD5J. — *WEG***

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Letters to ME

Math Tricks

I am writing to comment upon a letter to the editor in the Mar-Apr, 1995 issue titled *Math Tricks*. After reading the article I wondered about Jan Verhoeven's comments. So I decided to try my own analysis. Jan is arguably wrong. I found that it is possible to extract more precision from a A/D if you add noise to the signal before performing the conversion.

Simulation of a 1-bit analog to digital converter:

First comes the analog signal; 1 volt range from 0 to 1 volt.

Signal = .321459

I would take this signal and buffer it. To make it more interesting I would add some noise; 1 volt peak to peak and with a uniform distribution. I would feed this into the 1-bit analog to digital converter. The following creates an array of n samples of my signal.

Noise = 1 n = 4096 i = 1 .. n

$MySignal_i$ = md(Noise) - (Noise/2) + Signal

My 1-bit converter is simulated by the following function:

OneBit(x)= if(x >=.5,1,0)

This creates an array containing the ones and zeros that result from a one-bit conversion.

X_i = OneBit ($MySignal_i$)

The following finds the average of all the conversions.

((Sum all X)/n) = 0.325439

Pretty close to the original signal. I tried it with larger n and the precision improved. Thus by adding some noise and averaging many one-bit conversions you can obtain a more precise and accurate answer. In the big picture it was Jan that provided the comments (noise) on the original article (signal) and my analysis (one-bit conversion) that produced a more precise and accurate transfer of a significant idea.

Lou Abney
Houston, TX

Accountability

I have just finished reading *Accountability* by Bruce Boyes in the March/April issue of Midnight Engineering and, as with almost article in ME, enjoyed it very much. However, there is one point where Mr. Boyes is in error. To quote from page 26 "another Peachtree mind-blower: you can't change a bill of materials once you've used it!"

Peachtree is just enforcing good, industry-standard, change control practices. If you need to change a BOM, you have to create a revision. In most part numbering systems the revision number is a separate field from the part number, but for practical purposes it is part of the part number. Look at almost any printed circuit assembly and you'll find the assembly (part) number and revision stamped on it somewhere (the etched part and revision numbers are for the bare board). This is crucial for product support and sustaining engineering.

In Mr. Boyes case, if a customer called and said he had rev 1 of the assembly, he would know (or be able to look up) that the board had to have the resistor change made before it could be expected to work properly. The argument at this point is usually something like "But we never built (or shipped, or whatever) any of those." I won't explain why this argument doesn't hold water. I have been party to this discussion at, at least six different companies, and at some companies, more than once.

Carl Bergerson
Rancho Santa Margarita, CA

More Accountability

I thoroughly enjoyed the article *Accountability* by Bruce Boyes in you March/April issue. This is the best I have seen on the trials and tribulations of trying to get a small business computerized. After two years of struggle, I have encountered many of the same problems and come to some of the same conclusions as Mr. Boyes. I wish Mr. Boyes success in his "call to action," but I don't believe anymore that it is possible to write a complete all-in-one accounting package. The problem is the great diversity of business methods once you get beyond simple tracking of assets and liabilities. My business has no need for "MRP," but we do need a very versatile payroll program, capable of handling mixed piecework and hourly wages. In the big accounting packages, the manual for the payroll module alone is sometimes two inches thick! None of them will do what my simple spreadsheet does for my particular business.

What I have settled on in my business is a combination of Quickbooks for the basic accounting, a spreadsheet for the payroll and inventory calculations which Quickbooks cannot do, and a database for our customer invoicing and accounts receivable. My one wish for a future version of Quickbooks is that I can simply designate a range in a spreadsheet and have the data be imported as transactions, thereby avoiding about a half-hour a week of extra data entry (and the possibility of error).

Quickbooks has some really slick features, like checkbook reconciliation, and running balances on all the accounts, that would be very difficult to write ourselves. It also has some terrible limitations, like the maximum number of customers, which you cannot find anywhere in their documentation, or from their technical support. Had we started using Quickbooks two years ago for our customer records, we would have hit the limit, with no way to get the information out and into a standard database!

Each new version of Quickbooks has some nice improvements, and a load of features which I will never use. Take inventory, for example. I thought the latest version would be just what I was looking for. After several hours of experimentation, I decided to stick with our spreadsheets. As nice as it is, the Quickbooks inventory assumes you are selling exactly what you buy, like a retail store, not making big things out of little things. In our manufacturing, we have three levels of subassembly, and part of what we make at each level is sold to our customers, while the other part goes into the next level of our own production. This is, no doubt, more complicated than most businesses, but every business has one or more such

"complicated" operations. Programs that attempt to do it all, require a full-time computer-savvy bookkeeper (and a foot or more on your bookshelf).

Non-Integrated Accounting Software

No accounting package will ever beat a spreadsheet or a database for maximum versatility. The key to success is making the interface to the accounting package simple. At first, we thought we would use Quickbooks A/R capabilities, while keeping our database of several thousand customers in Q&A. The invoices are printed directly from the database (easy) and journal entries are made automatically for each invoice (also easy). To get this journal information into Quickbooks A/R requires a lot of data entry. Instead, we made the journal our record of accounts receivable, and entered only the total daily deposit into Quickbooks. Since then, we have added several different types of transaction to our journal, including bounced checks, redeposits, refunds and returns, and other adjustments. The versatility of the database makes this easy. We could never get the kind of reports we need out of Quickbooks.

We currently use Quatro Pro for our spreadsheet, but any modern spreadsheet will do, as long as it has "database" functions which allow you to select and sort rows based on values in a particular column. We currently use Q&A for our database, a decision which I have come to regret. This is a "non- programmable" database, and two years ago I did not appreciate the need for programming in a database. Non-programmable means there is no such thing as a simple variable. You cannot say "x = Account #" and later use "x" to avoid typing in the account number again. We got into this program because I was thrilled with the simplicity of the interface, and the ease of building forms. As our needs have grown, we have added many "specifications" and macros, most of which are critically dependent on trivia such as the location of a field on a form. Change the position of that field, and you will be chasing obscure bugs for months thereafter.

My current hope for salvation is Microsoft Access. When I get a little more time, I will rewrite our customer database as it should have been from the beginning. One warning, Access is not as easy as they claim, but it is much easier than dbase. Once you get past the initial frustration, the power is well worth the learning effort.

One thing to keep in mind when setting up a business with a mix of programs like this, is the tradeoff between development time and bookkeeper's time. Many people become obsessed with automating everything and will spend a week automating an operation that takes a bookkeeper 1/2 hour a week! True, the bookkeeper should not have to enter these numbers twice, but consider the value of your time compared to that of the bookkeeper. It may take many years to recover the cost of your effort. Also, there is a bad psychology that develops with too much automation. When the program spits out $6000 in payroll checks with one command, it is hard for the bookkeeper to look at each one carefully for mistakes.

If business was easy, there would be a lot more competition!

David MacQuigg
Gainesville, FL

Delegation Tax

Keep up the good work. I particularly like the notion of the "Delegation Tax" that you outlined in a recent editorial — it puts a label and a firm notion on something I've had a sense of for years.

I suspect many people tarred and feathered with the "Control Freak" label are really just unwilling to pay the delegation tax — even if they are not consciously aware of it.

Kevin Rhoads
Andover, MA

[I recently defined the concept of a "Delegation Tax" to help explain the entrepreneur's perspective on the cost of hiring employees. I wanted to quantify the costs beyond salary and benefits. For example, there is the costs of training,allowing for the inevitably higher error rate than you would make yourself, and the inevitable cost of hiring a substitute when this person quits or needs to be fired. —WEG]

Imagesetting Short Cut

I've been reading with great interest your articles on printing. I admire your way of attacking the printing business. I admit that I don't know a whole lot about the business, but I think I may have a short cut for you. I read that you were using film for camera ready copy. Also, I read about your experiments with color separations. Now I'm thinking why use film? Just do it all digital... Just do all your stuff on the computer then send the output go directly to a laser printer with transparency media i it. You can make negative or positive transparencies. "Laser Master" has machines that will print 1200dpi.

I love *Midnight Engineering*, it has given me a lot of ideas. Maybe one of these days I'll be an entrepreneur

Tim Prepelka
Pittsburgh, PA

[I have previously done just as you suggest. I had hoped that the negative image could be done on the transparency. The actual result was a very rippled piece of transparency with the image much more grainy than the Laser Master output to plain paper. The added problem with printing a negative image on the transparency is that it takes a lot of toner and is just not opaque enough. Now that I have a Lino, I can output directly to film negative at 1270 dpi and 133 line screen. The result will be cleaner color separations, and after I get the whole system calibrated (including the printing press) I will have something that looks good, is incredibly efficient for me, but also is consistent and predictable. .—WEG]

ME

Building Success

Extraordinary is the way I would have to describe the attempt to print this issue. The 100' long, 4-color, heat set web press that I am building is running, but that was only the beginning of several weeks of setbacks, interruptions, false assumptions, and general havoc that resulted in this May/June '95 issue being 4 weeks late. I had made the assumption that this issue was going to be the first one off the press. It wasn't that this would be an issue I would "try" to print. I assumed that things were close enough that it would be just a matter of pushing hard enough to make it happen.

We all make assumptions all the time — that's how we get through life. Our reality ends up being defined by our assumption set and we can actually manufacture whatever reality we want, I suppose. I tend to make lots of assumptions that hold up much of the time. So, when I entertained an unprecedented string of false assumptions, I found myself quite disturbed.

There are those, of course, that would say I was really DISTURBED to be attempting to build my own complete printing plant for the sole purpose of printing this magazine and saving myself a lot of time and money. Since the plant is mostly built and running — using 30 year-old equipment that was headed for the scrap pile — and I am on the verge of saving a lot of time and money, I will thumb my nose at the naysayers. Actually, I haven't run into any naysayers in a while. The project is too big and is going too well for anyone to realistically conclude that it can't be done. It is only a matter of time now. But, how close can you get to success without really enjoying it?

Close Is Not Good Enough

The answer, of course, is that you can be on the edge of success for a long time. It ends up that there is quite a bit wrapped up in the moments (or days or years) just prior to "success." I am happy to report that success is a matter of scale — independent of time. I have examined the process independent of the project, and have concluded that we humans "build" success rather than "have" success. In other words, we do lots of things that end up making us successful at something.

More interesting, I think, is that our individual success seems to be a matter of style to a large extent. In other words, how we individually define problems and the way we individually approach problem solutions is a significant factor in our overall success. I have observed that overall successes are built of small successes. While this doesn't seem too surprising, there is more to it than that. It appears that these small successes are the pattern that ends up defining our more significant successes.

So, if we are good problem definers and good problem solvers on the small scale, we should enjoy large scale successes. By the same token, if we don't do well on the small scale, then I would expect the large scale successes to elude us. But, that is making success too much of a step function. My point is that our "style" of problem definition and problem solution leads directly to the "style" of our success.

For example, dreamers are not doers — for the most part — because they fail to define the incremental steps that will take them down the path to their goal. They simply can't see the incremental, compartmentalized problems that, when solved, will build their dream. That is their "style" of problem definition and solution — in this case a recipe for failure even before they start.

Then consider the fellow that jumps headlong into creating situations and defining problems at the detail level that get the driving wheels really spinning without going anywhere. Somewhere in between is where we would like to operate.

I tend to look at the whole from wherever I am at. I see parallel paths that are already running and can create parallel paths starting at my current position, leading into the future. This has served me well, just as it does in computing systems that employ parallel processing CPUs. The trick lies in the willingness to abandon paths that don't "compute" — so to speak. In other words, you have to be just like those "stupid" CPUs that give up on parallel branches that have been followed simply because they were never taken in retrospect!

What is it that keeps us focussed on the wrong path or keeps us from moving down parallel paths that can be highly productive? In a word, it is EGO. That is what drives us all. Everything is traceable back to ego. This is where I have seen many entrepreneurs shoot themselves in the foot. They can't admit small scale failure as a way of moving down the road — in fact propelling themselves down the road.

Despite thinking that I had things somewhat figured out, I simply pushed too hard for too long and drove myself right into a corner. It's not the end of the world, but I took a considerable and escalating risk trying to print this issue that just didn't work out. I would not want to give up any of the progress that I made in the last six weeks, but I do wish that I hadn't consumed so much of my own personal time and energy trying to make this the first issue to print.

Bill Gates

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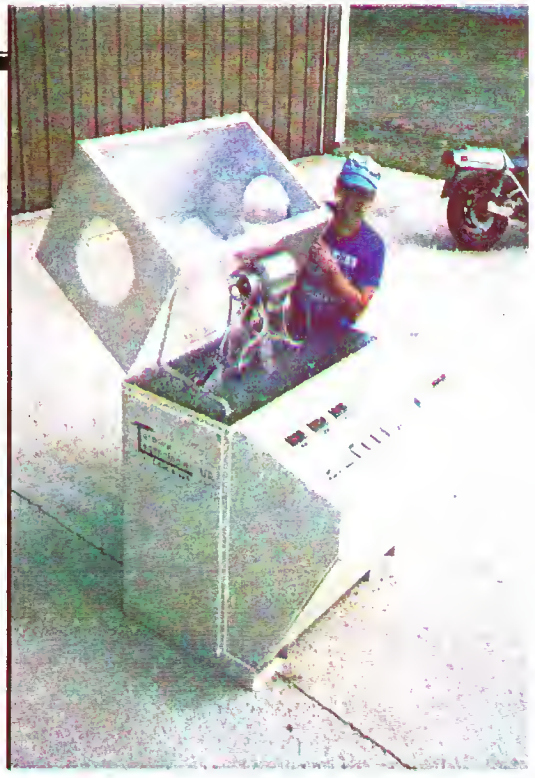
Turbine Entrepreneurs



by Jim Stone

Picture this: Berlin, Germany during late stages of World War II. Ten year old Wolfgang Kutrieb is walking through a field when the cold Autumn silence is ruptured by the world's first jet aircraft, a German ME-262 fighter slices through the sky. Sounds like a good lead in for a pulp fiction novel? No. In fact it was a life-defining moment for the entrepreneur and founder of Turbine Technologies, LTD.

I called Turbine Technologies, Ltd. and I spoke to Wolfgang and Michael Kutrieb. The Kutriebs immigrated to the United States in 1963. Over the years Wolfgang worked for other companies, went out on his own and invented several products, yet his professional interests was always with turbine engines. Wolfgang and his family of five started Turbine Technologies, Ltd., a company that for several reasons is as interesting as the 10.5 pound Jet engine that they produce.

Turbine Technologies, Ltd. located in Chetek, Wisconsin is possibly the only company of it's kind in the world, a family owned and operated firm that can design and build gas turbines, in house, from scratch! That's saying something.

What really is an eye catcher is Turbine Technologies, Ltd. show piece/test bed: a twin engine BD5J. The crowd draw factor at trade shows is phenomenal. Perhaps a lesson can be learned from the Kutrieb family — select a sexy test bed to mount your product on? Now the next time you're at a trade show will you see a C compiler stuck in a Ferrari?

You might remember the BD5J. It's a build-it-in-your-own-garage, personal jet aircraft designed by Jim Bede in the 1970s? I remember dreaming — okay lusting — over the BD5J before I even had a drivers license. The only problem then was finding the jet engine, now Turbine Technologies, Ltd. has developed the SR-30.

Turbine Technologies, Ltd. has also developed a flat panel digital display that is an entire monitoring system for the engines and other related flight functions and is installed in their BD5J. The flat panel display system is marketed in a joint venture with Knightronix, Inc. of New Brighton, MN.

I find it fascinating that a five person, family operation can manufacture a high technology super alloy, 90,000 rpm rotating turbo jet engine, in house — right down to the investment casting of the components. It's almost as fascinating as another entrepreneur you might be familiar with operating a one man printing press the size of a small town YMCA (only having fun Bill).

Turbine Technologies, Ltd. is pursuing the market niche of relatively low cost, small gas turbine engines and are currently manufacturing the SR30 turbo jet engine. The SR30 is 6.75" in diameter, 11.75" long, develops up to 45 shaft HP or 32 lbs. of thrust at sea level, all the while sipping seven gallons of fuel per hour.

Because thrust is a force and only becomes power when an engine is moving with the airframe, a direct conversion of thrust to horsepower is not possible. Michael Kutrieb, Wolfgang's son, who is also a jet propulsion engineer, and multi-thousand hour professional pilot, was extremely helpful in explaining the conversion formula, but this is as simple it gets:

1 Thrust horsepower (THP) equals 1 lb. of thrust at 33,000 ft./min. or 375 MPH. Therefore, if a prop, fan-jet, or turbo jet vehicle would fly at 200 MPH with 150 lbs. of thrust, the THP calculation would be: THP = 200/375 (150) = 79.5 THP.

Now I can't match Wolfgang's ME262 experience, but as a youngster growing up in the midwest I remember going to the Indianapolis Motor Speedway for a practice session during the 1960s. At "The Indy," I saw a piece of machinery that has stayed in my dreams ever since. The dream inspiring engineering wonder (at that time) was the STP Andy Granetelli turbine powered race car.

Though I have logged time flying turbine helicopters, I'll probably never own a personal jet aircraft, but the memories of the STP racer and the SR-30 somehow became intertwined. I began to wonder how an engine like the SR-30 could be used by the masses. I had to find out more about automotive gas turbine applications.

I researched more and ran into an article that was written by David Gordon Wilson. David is a MIT professor, author of *The Design of Gas Turbine Engines*, and a member of several alternative automobile engine study commissions. The facts and research appeared in David's recent article *Turbine Cars* in *Technology Review*:

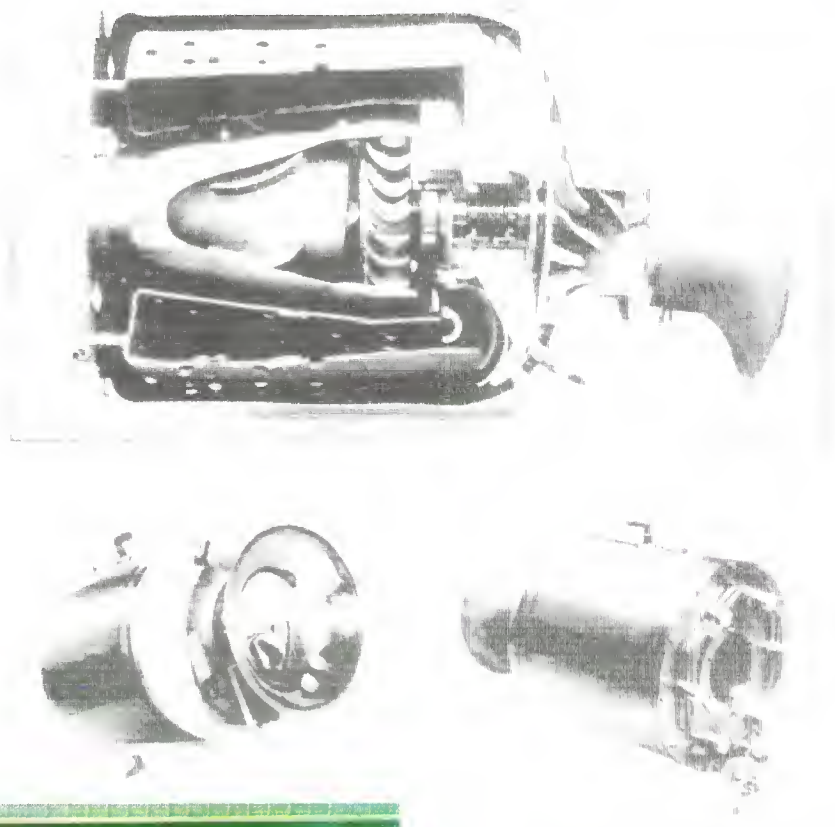
Gas turbines begin to make sense from a fuel emissions and durability standpoint when compared to spark ignition engines due to less mass, longer intervals between service, and attain-

able thermal efficiencies in the mid-40s versus the mid-20s of piston engines.

It is very possible that a mid-size car could attain 80MPG with certain improvements to today's automotive gas turbine engine. The largest potential for increasing efficiency is via the use of injection-molded composite technology for the compressor blades and ceramic technology in the compressor, turbine rotor, combustor, turbine housing, and regenerator of the automotive turbine.

Wilson believes the redesign of the regenerator to be one of the most significant gains in increasing efficiency for the automotive turbine. The regenerator is in essence a heat exchanger that captures heat from the hot exhaust gasses and transfers it to compressed air entering the combustor, resulting in increased efficiency.

After a turbine has been operating for several hours, up to 14 percent of the flow of compressed air escapes through the seals in today's slow (3-10) rpm



rotating regenerators. The seals are actually machining themselves down as the engine operates. MIT is developing a "stepper" ceramic regenerator that rotates approximately 30 degrees and has seals that clamp and unclamp (distance of seal movement about 50 microns) on the regenerators surface during the step cycles.

Today's automotive turbine regenerator designs recover 90-93 percent of heat to be reused, increases up to 97-98 percent are possible by simply increasing the thickness and diameter of the rotating discs.

Reducing the compression ratio reduces the speed of turbine rotation and reduces the stress on other components, most importantly the compressor blades. If the regenerator's effectiveness is increased the optimum pressure ratio can be decreased from today's 6:1 ratio down to 3:1.

Increasing the stages of compression on small turbines from one to three reduces stress and velocities further and increases efficiency. A multiple stage compressor also makes more use of the kinetic energy that flows from the first to the subsequent stages of the compressor. On single stage turbines, kinetic energy cannot be recovered and is wasted.

If we can lower the speed of turbine rotation, which decreases the operating temperature, and greatly reduces the stress, can we not change from today's current use of aluminum for the compressor blades? Wilson believes that the blades can be injection molded out of fiber-reinforced, high-duty resin (e.g., polyphenylene sulfide, polyetherekетone, or polyethersulfone).

The finishes of the composite blades are capable of being smoother than cast aluminum so friction should be reduced and efficiency again increased. Wilson believes the lighter weight composites would lower the compressor's rotational inertia and thus improve the engine's responsiveness. By using the

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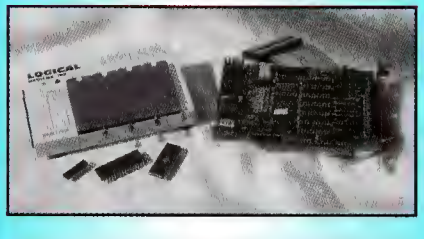

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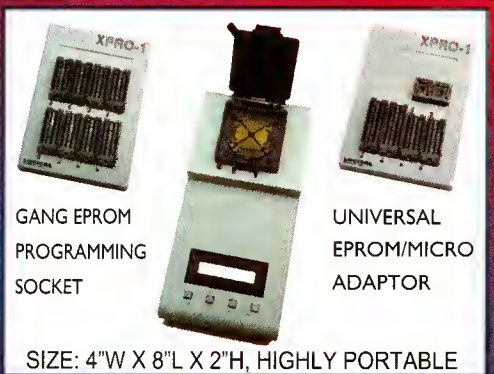

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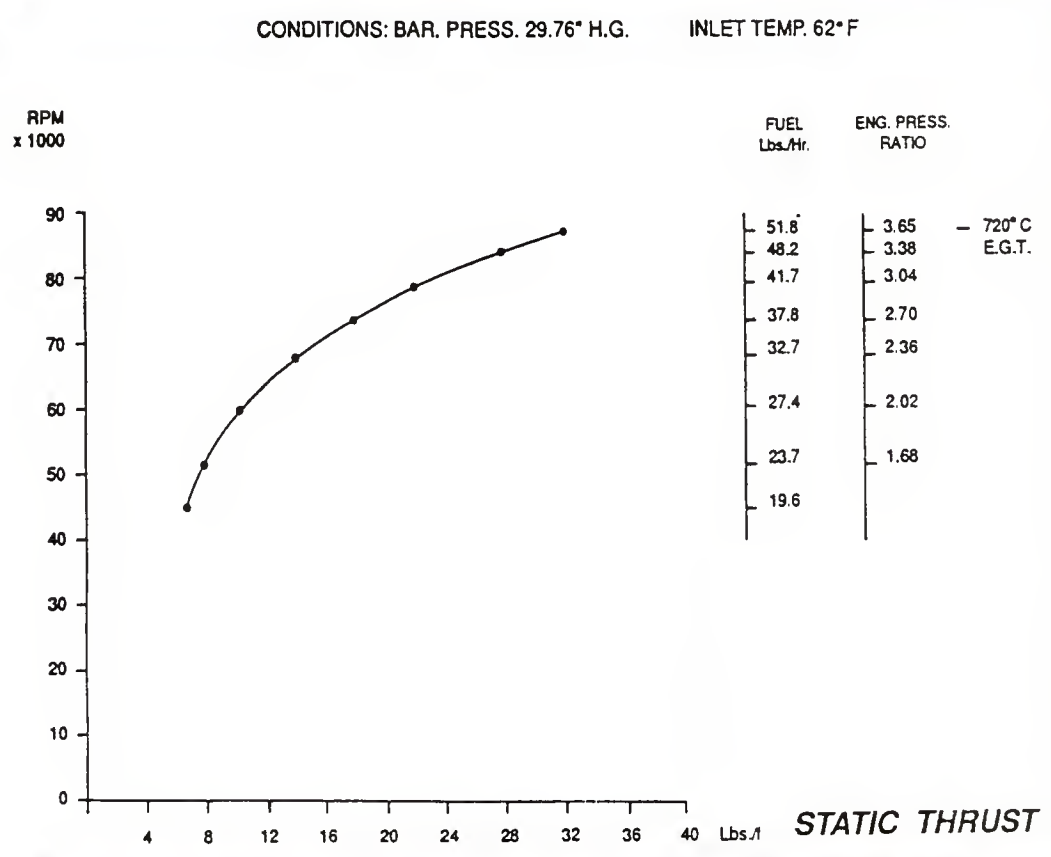

composites, the manufacturing costs could possibly be reduced too.

Aviation Week & Space Technology recently had an article on turbine hybrid racing technology involving team Chrysler and Satcon. Chrysler has long been associated with automotive turbines (1965 10th place 24 hours of Le Mans, driver Noel Penny) and producer of 200 gas turbine test vehicles in the mid-sixties. Satcon Technology, to develop another turbine racer.

Satcon, a small company comprised of MIT professors, is using their expertise of satellite stabilization using high power density motors, magnetic bearings, energy-storage flywheels, and turboalternators to contribute significantly to the race program.

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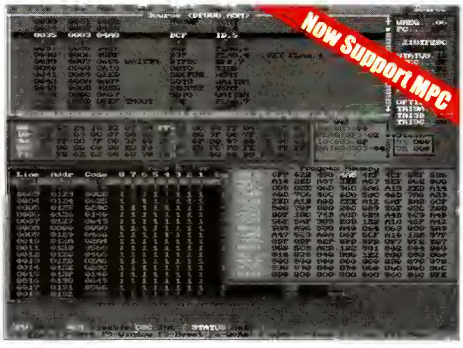

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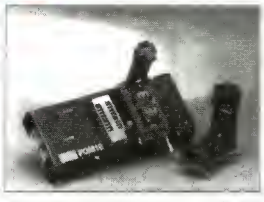

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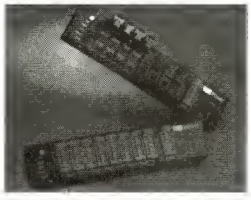

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A concept that Satcon uses, an energy storing flywheel, (the flywheel is suspended in a vacuum and spins upwards of 58,000 RPM) would be great to adapt to the consumer turbine hybrid vehicle. The energy storing flywheel in the big dollar project (batteries in the M.E. low dollar project) stores additional energy used when needed for additional acceleration. Satcon and Chrysler believe their 2000 pound vehicle will develop 500 plus HP and could exceed 240 MPH.

Satcon's flywheel weighs 135 pounds and will store up to 4.35kw. per hour of energy. In the article from AW&ST, Satcon's president and chairman David Eisenhaure claims that the storage capability of the flywheel is 50 times that of lead acid batteries. The article also claims that the potential exists for a consumer vehicle to have the potential of reaching an economy level of 80 MPG and having the performance of a sports sedan.

In other related technology projects of Satcon's, machines have been produced that operate at higher than 90% efficiency with densities of 7.5 HP or higher, compare that to the average home appliance.

After doing all the research, it all comes back to the question of whether you have the budget to redesign the jet engine, and use or develop similar satellite stabilization components.

But why re-invent the wheel? I believe the real opportunity lies ahead for the integrator of coupling devices and mechanisms from turbines to power generation devices for hybrid electric automobiles. Initially I was all caught up with coupling schemes of transmissions, sprauge clutches, gears, shafts and what-nots. I quickly realized that the beauty of the turbine design in itself and how others have used it's by products (massive quantities of air at high volume) to solve design needs.

Look at the technology used in the Notair (tail rotor-less) system used by Hughes Helicopters. It is basically a duct that bleeds turbine exhaust gases into a chamber that turns a multiple bladed fan. The air from the fan is expelled through a series of ducts along a moment arm (tail boom). This technology obviously works because the forces

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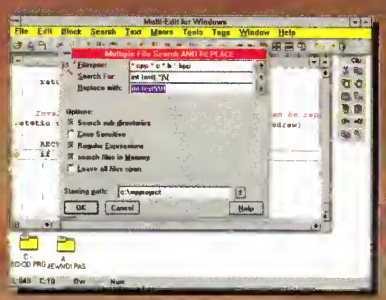

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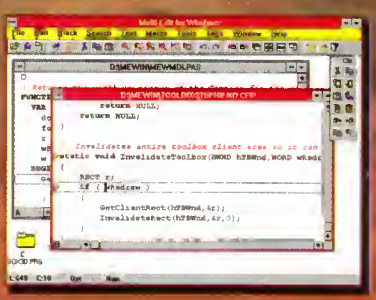

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that are produced are sufficient to counteract the torque that is produced by the rotor system (even during sideways flight of about 50 MPH).

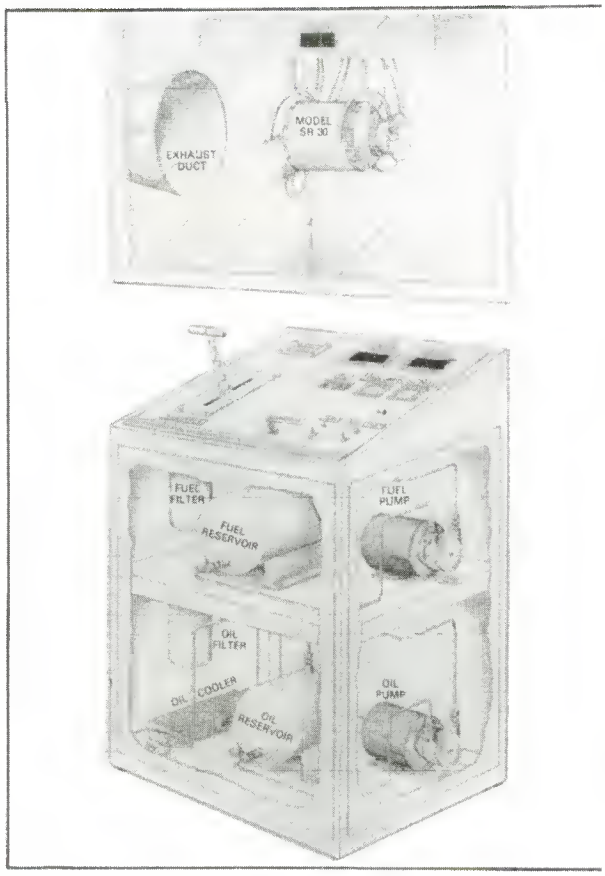
A trip to the junk yard may yield a possible prototype. A potential exits to channel the exhaust of a small Turbine Technologies, Ltd. style engine into a single, or via a manifold, multi-stage turbocharger styled alternator/generator. The article by David Gordon Wilson referenced silicon-nitride ceramic turbochargers that Nissan introduced in 1985, could someone using backyard Midnight Engineering techniques produce a prototype?

The optimum for the hypothetical M.E. turbine hybrid would have to have a battery assist that could be used for situations that don't warrant spooling up a turbine (e.g., moving the car 10 feet so someone you parked in front of can leave). Perhaps the vehicle could have enough battery power to permit travel for up to 3 miles for small trips to the store? The battery bank could be used when additional power would be required, such as sudden acceleration, and the turbine could continue to run when parked until the recharged takes place, or perhaps solar cells could be used.

I would love to see the mathematical results of the viability of turbine automotive hybrid projects. If you work with turbine generation or hybrid automotive technology I am interested in viewing your reports.

I am a firm believer that, as entrepreneurs, we should learn as much as possible from our governments funded research. Coupling that with the MIT researchers findings, we should be able to grow empires from the grass roots.

With companies like Turbine Technologies, Ltd. that have complete in-house design and manufacturing capabilities, (and that are free of bureaucracy compared to the big guys), information exchange, and project partnerships could make a lot of sense. Project partnerships that in turn can bring seed money and/or grants to develop existing technologies such as fuel efficient gas turbine automotive applications.



Turbine Technologies, Ltd. is located at 430 Phillip St, Chetek, WI 54728 and can be reached via 715-924-4876 or by FAX: 715-924-2436.

If anyone has any more information about small turbines, hybrid automobiles, or that could put me in contact with Jim Bede or Burt Rutan for an upcoming article, please contact me.

ME

Jim Stone is an On-Line documentation developer specializing in help files for Windows based programs and a free-lance technical writer. Jim is always interested in hearing about new and existing technologies for future articles, especially aviation and simulation products. Jim can be reached at 407-423-7750 or e-mail to write1@civ.net

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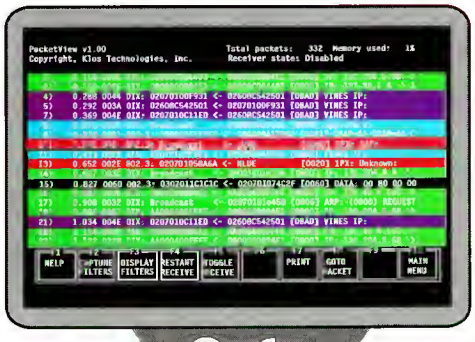

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Reader Service Number 25

Friends in the Business

by John Dybowski

Engineers sometimes single-mindedly perfect their technical craft to the exclusion of cultivating other, shall we say, more pragmatic traits. It should come as no surprise that companies perceive this situation very favorably. These very individuals contribute quite handsomely to their bottom line. The age-old problem with this scenario is that seldom is the compensation package commensurate with any actual contribution. Rather, the numbers are simply based on the going rate. Worse, after years of dependable effort these individuals might come to find their services no longer required. Things change. Who can you trust?

Lacking any business sense and business contacts these hapless individuals might eventually find themselves at a serious disadvantage if at some point they decide they'd really be better off channelling their efforts into their own business venture. While no one would dispute that in such a case it's a good thing to hit the ground running, there's no reason that with a some diligent effort and clear thinking, past delinquencies can't be overcome in short order. As usual it's a matter of assimilation. That is, figuring out how the system works and then working it to advantage.

If we accept that there's nothing more valuable than having a friend in the business, how is one to proceed in launching a startup manufacturing firm (or any other business operation for that matter) without such a valuable resource?

After you've developed a manufacturable product your attention quickly turns to making others aware of what you've accomplished. Naturally, you focus on getting as much affordable press as possible within the constraints of a limited budget. Of course, what you're looking for is access to a certain caliber audience. One that is well-suited to the product you are interested in selling. One that is ready, willing, and able to buy.

This is an important point since tapping into the wrong customer base can cause major problems. Not only could this prove wasteful in itself, but the long-term fallout can cause ongoing problems. Targeting the right individuals is just as important as sizing up your intended customer base in the first place. I've seen companies that have pursued the low-end and established reasonable sales numbers only to eventually succumb to the extreme demands of supporting a large number of inexperienced users. The road to ruin turned out to be the inordinate amount of customer support that they had to expend. A $49.95 product along with a $10 phone bill and an equal amount to your precious time just doesn't add up. That's not to say money can't be made low-balling, but you better fully understand the ramifications of such an undertaking before getting in too deep.

The Middle Ground

With a considerable background in embedded system design I started my enterprise, Mid-Tech USA, to produce mid-range embedded computing devices for engineers, consultants, and OEMs. Mid-Tech's charter also implies the utilization of the vast stable technology base that forms the middle ground between the opposing sectors known as low-tech and high-tech. Make no mistake, that which is often touted as high technology is nothing of the kind!

Having established this rational scenario, Mid-Tech's first two major prod-

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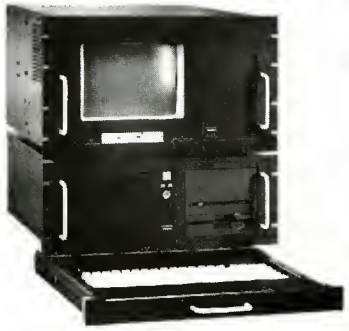

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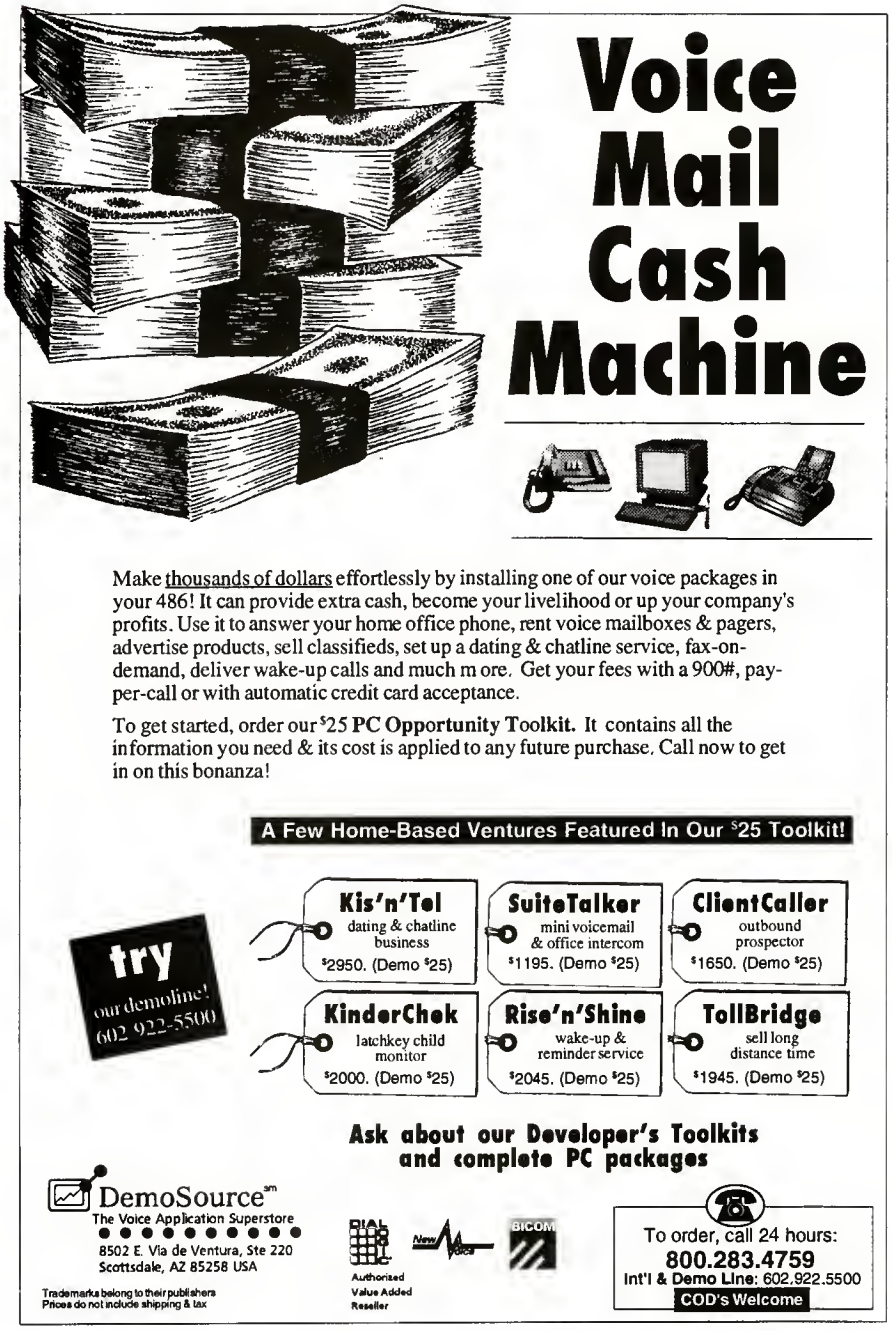
uct offerings fall just this side of real high technology. These are very high performance single board computers based on Dallas Semiconductor's enhanced 8031 processors. The ec.32 and ec.52 operate under control of the DS80C320 and DS87C520 processors running at 25MHz and 33MHz respectively. These advanced processors receive an additional performance boost from architectural improvements that remove wasted clocks from certain instructions and execute the basic machine cycle in four clocks rather than the twelve consumed by a traditional 8031 implementation. Combining these architectural refinements with the increased crystal frequency yields a maximum throughput of 6 MIPS for the ec.32 and 8 MIPS for the ec.52.

Raw processing power in an embedded computer is meaningless without I/O. By definition, embedded applications involve interaction with real-world devices — monitoring and control. Both Mid-Tech systems provide dual hardware UARTs with RS232 and RS485 ports, parallel I/O, a real time clock, serial nonvolatile memory, and an I2C subsystem that can be used with general purpose devices as well as with Mid-Tech's I2C LCD/keypad peripheral. Utilizing I2C for the LCD-keypad peripheral lets both systems support a 20 x 4 LCD and 4 x 4 keypad (and beeper and LEDs) without unnecessarily burdening the fundamental design. For those implementations that don't require this capability, the two I2C lines can be used as general purpose I/O bits. Unlike a traditional LCD/keypad user I/O implementation, my I2C approach carries very little overhead.

The ec.32 provides 8-bit 0-2.5V analog I/O in the form of a quad simultaneous sampling ADC and quad double buffered DAC. Based on LS and F logic elements, the ec.32 is powered by a switch-mode regulator to keep power dissipation in check. The ec.52 provides an 8 channel ADC that resolves to 12 bits and operates from 0-4.096V. A low dropout linear power supply is a sound choice here since the system is fully CMOS — ACQ, AC, and HC logic is used throughout. Both systems feature battery-backed program and data RAM and EPROM program memory. These SBCs support a formidable list of features but material cost is relatively high. Keep in mind that, due to their performance capabilities, these systems traverse into application areas that until recently were the domain of 16 bit controllers. You don't get something for nothing.

With all the work and resources put into developing these systems you might be surprised that I freely acknowledge that what I've just described amount to no more than half a system. Of course, the missing ingredient here is solid software support. Fortunately, this fact has been apparent to me from the outset. As work was progressing on the system feature, set definitions, and PCB layout, Mid-Tech was forging an alliance with Canada's Dunfield Development Systems. This arrangement has yielded a full featured DS80C320 family simulator, remote debugger, and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COD's Welcome

cross assembler package. Full C language support is available through the Micro-C developer's kit. Both packages provide a multitude of support utilities, examples, and full documentation.

On the subject of C programmable single board computers, I'll be the first to admit that any given system can be programmed in C (or any other language for that matter). The truth of the matter is that some are more C programmable than others. It really boils down to the degree of support you intend to provide. Recall those that take an 8031, an address latch, an EPROM and proclaim the creation of a high technology venture. *Buyer Beware.*

My initial reason for pursuing Dunfield's Micro-C for use with my computer products was one of accessibility. Accessibility to library source and, equally importantly, accessibility to the programs' creator. Having used a number of the, so-called, high-end C compilers on the market, I was pleased to discover how favorably Dunfield's product compared in both code size and execution speed. Admittedly not the trickiest code generator on the market (his is the canonical stack based implementation), Dunfield gains his performance edge from cleverly hand optimized assembler library functions. And if you want or need to dabble, all library source is included with the Micro-C package.

I think Dunfield wins hands down in offering competent and personable customer support. (Frankly, the support I've received from some of the big-buck guys has left me a bit flat to say the least.) I've even come across some people that own both the Dunfield package as well as the high-priced brand and a number of these individuals indicated that they use Dunfield's product simply because they like him better. Obviously, there's a lesson to be learned here!

Dunfield's an outstanding guy but he's also a good businessman. In spite of my coaxing, he left it to me to write the custom library functions that support the special features of the ec.32 and ec.52. These Mid-Tech custom libraries support all of their respective system's local and remote I/O devices, provide dual console I/O for both serial ports, and have all delay routines tuned to work with the systems' respective crystal frequencies. If you insist, I also provide a set of support services for the popular Franklin/Keil compiler.

The Name of the Game

Let's face it, in many markets the name of the game is product differentiation. So, it should be obvious why I set out to developed the highest performance 8031 compatible single board computers in the world. The embedded computer market is served by a very wide cross section of manufactures with widely varying capabilities. The problem is that the cost of entry into this market can potentially be low enough to allow individuals with dubious competence to set up shop. This, in turn, makes for a rather strange mix of products many of which have no apparent distin-

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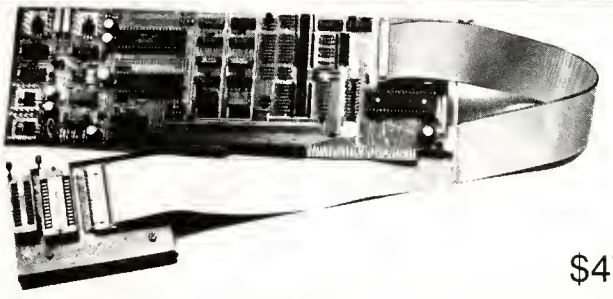

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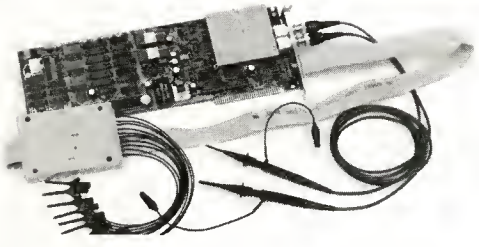

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guishing features short of price alone. It follows that providing a unique feature set allows you to set a reasonable pricing schedule that you can live with. Most importantly, the product may actually be perceived as newsworthy. This leads back promoting the product.

The electronic marketplace is served by a number of publications that exist because they have advertisers that pay the bills. Most of these also have news sections that report on new product developments (and, as a result, serve to enlist new advertisers). Many of these magazines are real heavy hitters in that they have a substantial hard boiled readership comprised of engineers, managers, and other decision makers. Indisputably a very focused group.

Not to pass up the opportunity of addressing such a select group, I decided the most sensible way to kick things off would be to issue news releases about the new embedded computers I had developed. Not having written a news release before, I proceeded by first studying some professionally written releases to get a feel for the general protocol. I discovered that, within the constraints of a stylized format, there is adequate latitude to say what you want to say the way you want to say it.

Once I was comfortable with the format, I shot off about 20 news releases to some mainstream, as well as not-so-mainstream, publications. Each was accompanied by a photograph of the system described. Unfortunately, timing constraints (my old foe) forced me to utilize pictures of the prototype systems, something I would not recommend. I feel the appearance of the photos limited my exposure in a number of cases. Although it would undoubtedly be preferable to present the products as much as a "production" system as possible, a number of magazines ran the submitted photos. Some even requested color reproductions.

My initial news releases were presented back in August of 1994 and news items are still appearing. Mid-Tech products have been featured in trade journals such as *EDN*, *EDN Product Edition*, *Industrial Computing*, *Embedded Systems Programming Product News*, and *OEM Technology and Exposition*s among others. *Electronic Products* just featured the ec.52 in the April issue in their board update section. The editorial world seems to move very slowly and I expect further releases to continue to appear.

The transmogrifications the original releases have suffered prove to be rather interesting to say the least. I've seen everything from verbatim transcriptions, to complete rewrites. One very reputable magazine even took it upon themselves to combine the ec.32 and ec.52 releases to create a hybrid product based on the two existing systems. You have to take these things in stride, since errors (even big ones) are inevitable. The idea is to rectify any misconceptions that may have been introduced with your follow-up literature. All in all, the outcome has been positive, resulting in hundreds of solid world-wide sales leads thus far.

Tightening Focus and the Waiting Game

Startup dollars are usually in short supply. Given this limitation, money is often best spent on improving the manufacturing process and accumulating inventory. At the same time, without sales these activities are all for nothing. I'm a believer in the positive results of proper advertising. Unfortunately good ads can tie up a significant amount of money. Armed with this knowledge, early in the game it became evident to me that I indeed needed a friend in the industry. As luck would have it I had nurtured some personal contacts at Dallas Semiconductor.

Following initial conversations with Dallas on what I had set out to accomplish the second and third ec.32 and ec.52 prototypes (right after Mid-Tech's and Dunfields's) shipped directly to the factory in Texas. (The systems were designed to maximize their usefulness and with the software support we've provided they prove to be perfectly adequate full-speed evaluation systems for Dallas' high speed micros.) It was extremely important to me that Dallas Semiconductor was aware of what I was developing. They accepted without reservation that the systems were good ones and they en-

dorsed my efforts. The systems were well received although they have subsequently evolved into something quite beyond the early prototypes that were so rigorously checked out.

Regrettably, after months of testing and evaluation at the factory and after gaining Dallas' approval, the ec.52 languished for lack of DS87C520 silicon. The sad fact is that the electronics industry in general and the semiconductor industry in particular are notorious for badly slipped schedules. Having a hundred fully populated ec.52s on the shelf (less processors) left me with a bit of a sinking feeling. After all, the system was intended to be the world's fastest 8031 compatible single board computer. Needless to say, without processors the boards represented a very significant non-salable resource investment that was going nowhere fast.

As the silicon was being perfected another delay was being played out. This was the seemingly endless sequence of holdups that plagued the release of Dallas' high speed processor data book. Now nearing completion, this data book has a special significance to me. Representing yet another heavy dollar and resource investment this, you see, is my ultimate promotional vehicle. Once the book hits the streets, look to the section on third party development tools. Mid-Tech USA is represented in a multi-page spread detailing what we are, what we do, and the products we offer in support of Dallas' high speed microcontroller products.

Although at this point success is by no means assured, things are definitely starting to pick up. I've utilized the seemingly endless project delays to bring the systems to a higher level of maturity than I had originally expected. The only major enhancement that is still pending is the ROMing of the Micro-C run time library. (Again, the benefits of working with Dunfield Development Systems.) For those applications where the systems operate under control of programs stored in program RAM, this will significantly increase the amount of memory available for applications and will serve to significantly reduce load time. Since the PC debugger and SBC kernel communicate over a high speed serial link using a purely binary transfer protocol, the load operation will be almost instantaneous.

My ec.32 and ec52 systems are starting to gain notoriety and are being well received by the embedded community. Work is proceeding on the next installment is this series based on the DS87C530 processor. This is a very small, extremely dense, high performance system with some very special capabilities.

I'm also waiting to hear how things are progressing with a Mid-Tech system that is being evaluated in Russia. It appears I now have friends in Moscow now too. Stay tuned.

ME

John Dybowski can be reached at Mid-Tech Computing Devices USA, POB 218, Stafford, CT 06075, 203-684-2442 (voice/fax).

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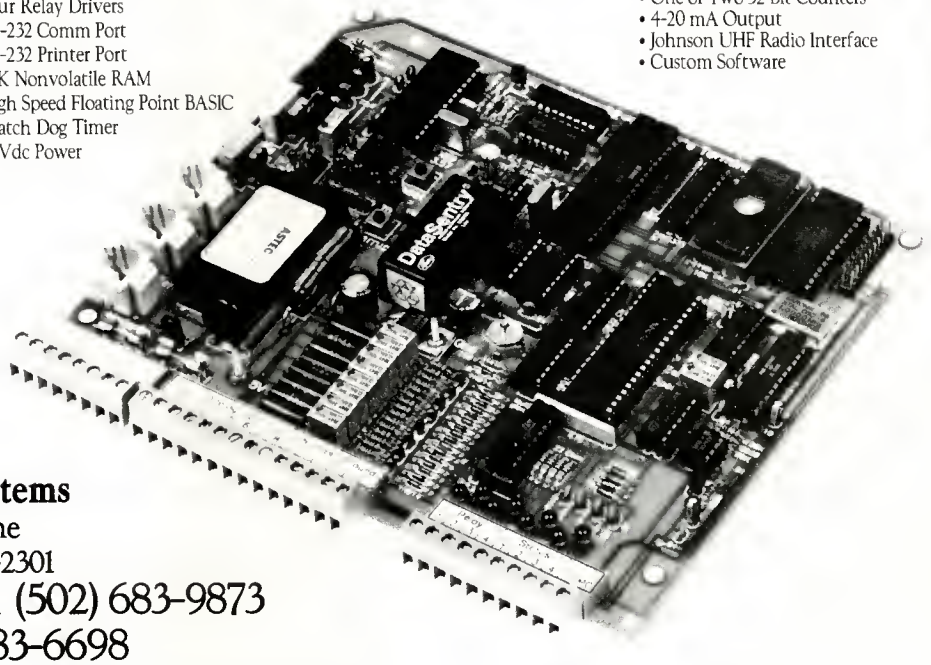

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Low-Cost Parts

by Robert J. Lockhart

Tooling costs can kill your project! With a finished widget design, you may find yourself facing a surprising quotation for that last little plastic part you need. The cost per part may be only 16 cents, however the injection mold tooling costs could be as high as $25,000! Since your spouse will not let you sell the kids, the death of your dream may seem imminent. Wait, there is a ray of hope. It's called Spin-casting.

Spin-casting is a technique that is readily available and quite cost competitive for small to medium run parts (up to tens of thousands). The final product can be either plastic (various quick setting two-part polyurethanes, epoxies and polyesters) or metal (lead and various tin and zinc alloys). Another advantage of spin-casting is that, unlike hard tooling, some under-cut in the molded part is possible due to mold flexibility.

In order to use the spin-casting process, a pattern must be created (preferably more than one for the purposes of balance). As the finished product can be no better than the pattern used to create the mold, use of a skilled pattern maker may prove to be a worthwhile expense. Also, with a quality pattern, tolerances of +.005/-.008 in/in can be achieved in the final molded part. The preferred material for the pattern is aluminum. Aluminum is easy to machine and can withstand the temperature and pressure of the mold making process. However, I have had acceptable results with other materials such as glass reinforced epoxy (G10 or FR4 circuit board material). Another point to consider, as with all molded or cast parts, is the part shrinkage during the solidification of the molded part. In addition, when the mold cures, the mold also shrinks making the cavity larger. Therefore, if there are critical dimensions on the molded part, the pattern should be oversized to accommodate the shrinkage. A typical shrinkage value, due to the two offsetting shrinkage factors, is 1.5 percent. But, shrinkage is material dependent, and the spin-caster should be consulted prior to pattern fabrication.

The first step in the spin-casting process involves using patterns to create a multi-part mold from uncured silicone rubber (other lower cost organic rubbers may be used for low temperature lead or tin alloys). The patterns are pressed into a layer of silicone rubber and other layers of silicone rubber (which is hand moldable like clay) are built up around the patterns. The mold parting line is formed at this time and mold parting compound is sprayed on the mold. The fully assembled mold is placed in a ring

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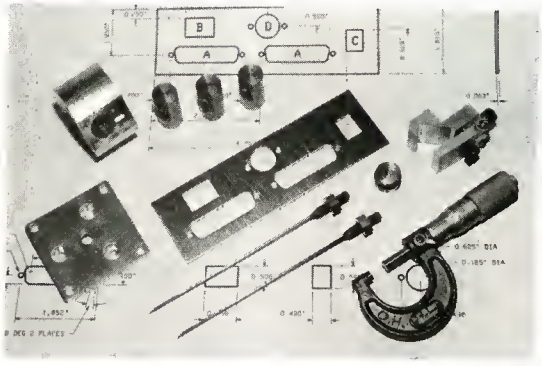
Reader Service Number 11

Metal Work



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Reader Service Number 120

shaped frame and cured in a hydraulically powered, electrically heated platen press at approximately one thousand pounds per square inch and 350 degrees Fahrenheit.

Once the mold is cured (vulcanized), the mold is separated and the patterns are removed. In order to facilitate the flow of liquid plastic or metal, a system of "runners" and "gates" are cut (using a sharp knife or scalpel) into the mold from the central core to the cavities created by the removed patterns. The gates are narrow passages that provide the actual entry location of the liquid plastic or metal into the cavity created by the removed patterns. The gates also provide an easy means of breaking the finished part from the runner system. The runners are significantly larger than the gates and they provide the flow path for the liquid plastic or metal. Also, air vents are cut and/or drilled into the cavity to aid in removal of entrapped air or gases. The mold can now be reassembled and is ready for the spin-casting process. The cost of a mold, including labor, typically ranges from $35 to $150.

With the mold reassembled, it can be loaded into a spin casting machine. The spin caster is started and the mold rotation accelerates to 100-1000 RPM, depending on materials used and molded part configuration. The centrifugal force on an object weighing one ounce when it is spinning at 1000 rpm and at a radius of eight inches, from the center of rotation, has an apparent weight of over fourteen pounds. The centrifugal forces develop the pressures necessary to force the liquid plastic or molten metal into the voids of the mold. When the spin-caster is at speed, the liquid plastic or molten metal is poured into the center of the spinning mold. Within minutes, the molded part has solidified and can be removed from the mold. Cycle times for metal can be as much as 50 to 60 cycles per hour. While plastic parts can achieve 10 to 15 cycles per hour.

As with all molded parts, some cleanup may be required. The parts will have to be cut or broken from the runners at the gates and there may be witness lines at the mold seams. Many parts can be used directly from the mold (for assembly, painting, plating or coating) as spin-casting is a precision casting process. However, if required, part cleanup can be readily accomplished using standard techniques and equipment such as bulk tumblers or by simply individually sanding the parts.

The bottom line: parts literally cost pennies apiece with minimal tooling costs. In addition, when a mold wears out, it can be repaired or another can be easily made from the original pattern. Also, as the design process often is evolutionary, design changes can be readily implemented without incurring expensive tooling costs. Refer to a manufacturer's directory such as the Thomas Register for a Spin-cast firm near you.

ME

Bob Lockhart is President of Dyrek Solutions, Inc., a consulting firm providing analytical and product development services such as stress and thermal finite element analysis, mechanical and hydraulic design, electronic packaging and manufacturing process optimization. He may be reached by voice or Fax at 203-526-8205; e-mail at 76740,3256 on CompuServe; or at Dyrek Solutions, 164 Winthrop Rd, Deep River, CT 06417.

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Reader Service Number 14

Rapid Product Development

by Alan Macy

November 17, 1994 was the day I got hit with a new software product. I mean it really hit me. My head jerked back and I said "Wow, why didn't I think of that before!"

The utility application I envisioned would be quick to develop, and extremely useful to others. I realized that as a one-person company, I was flexible enough to put aside my other projects for a few weeks, and get this new product to market.

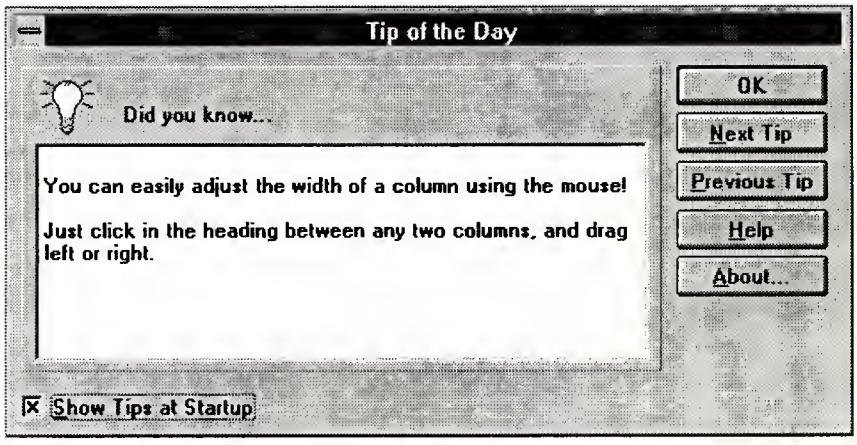
What follows is a day-by-day diary of my work on the new software program, from conception to release. I hope to...

- **Show you that it is possible to create a marketable product in only one month.**
- **Demonstrate that if you already have the infrastructure in place for selling products (your business license, bank accounts, equipment, software, credit card merchant account, etc.), developing a second product is much easier than producing the first.**
- **Discuss the benefits of selling more than one product.**
- **Pass on the resources I've used and tips and tricks I learned, including my checklist for all the things that needed to be completed before release.**

Thursday, Nov. 17

I was working on version 2 of my Windows time and billing application, Responsive Time Logger. I had found that version 1 customers sometimes called in to request features which were already present. For example, someone would call and say "I love Time Logger, but I sure wish I could adjust the width of the columns using the mouse." Well, it is possible to do this, but the customer had missed this feature when reading the manual.

To solve this problem, I thought I'd add a "Tip of the Day" dialog to version 2. Every time the program was launched, the user would be presented with a simple productivity tip. Something like this:


Tip of the Day
Did you know...
You can easily adjust the width of a column using the mouse!
Just click in the heading between any two columns, and drag left or right.
OK
Next Tip
Previous Tip
Help
About...
Show Tips at Startup

Note that the basic idea was not mine; Tip of the Day dialogs are found in other applications such as Word for Windows 6.0 and Quicken.

This is when the idea hits me. Why not write the Tip of the Day feature in such a way that others could easily install it in their applications. I would then market it as a product in its own right. Developers could add the dialog to their app in about half an hour, and create a simple text file full of tips on the use of their application.

I realized that this utility could even be used by non-developers. For example, a department manager could create a set of tips concerning the use of the company's software, and have the Tip of the Day dialog appear whenever novice users booted up their machines.

I had to write the Tip of the Day code anyway, so I had nothing to lose!

Friday, Nov. 18

I start programming. I also put the following request for beta testers in several programming forums on Compuserve:

I am looking for a limited number of beta testers for our new product. The product allows software developers to add a Word-for-Windows-style Tip of the Day feature to their applications with a single, simple call. The beta software will be distributed via Compuserve (the files should be quite small). If you're interested, respond to me via e-mail, and include your name address and fax number (so I can fax you the non-disclosure agreement).

The non-disclosure illustrates why developing a second product is so much easier than developing the first: I already had a non-disclosure agreement prepared (The NDA refers to the agreement between the beta tester and you, in which the tester promises to keep your product secret in exchange for a free copy of the program). For my first product, I had to get legal books, put together an agreement, proof read it, etc. For this second product, I just changed some of

the text in the previous document file and printed it out.

Saturday, Nov. 19

I complete 80% of the programming, working with Microsoft Visual C++, version 2.0. Remember, the product is very simple: It simply puts up a dialog, and reads in tips from a text file.

I put together a checklist of tasks remaining in the project. Here it is, along with the dates that the tasks were eventually completed:

Task	Completed On
Add to Time Logger	11/22/94
Beta Test Forms (to report bugs, etc.)	11/26/94
Beta Testers	11/28/94
Choose Product Name	11/22/94
Create and Test Sample Code	11/30/94
Diskette Labels	12/16/94
Finish Testing	12/05/94
Installation (The Setup Program)	12/05/94
Manual	12/16/94
Packaging	12/17/94
Press Release, Distribute	12/12/94
Press Release, Finish Writing	12/09/94
Press Release, Write First Draft	11/22/94
Screen Shots	11/22/94
Tips for ZipTip Itself	11/28/94
Trademark Search	11/22/94

Sunday, Nov. 20

I take the day off, but do some brainstorming concerning the product name. The name I came up with was "ZipTip."

Here's yet another example of why a second product is easier to develop. When I created my first product, I naively figured I would call it "Time Logger," since that communicated what it does. However, I later found out that that was a terrible name because it was not a strong trademark. One may as well try to trademark a product called "Word Processor." At the last minute, I changed the name to "Responsive Time Logger." That was still not ideal from a trademarking point of view, but it was too late to make a more radical change.

So, based on my earlier mistakes, I knew that "ZipTip" was a pretty good name.

Monday, Nov. 21

I plug ZipTip into version 2 of Time Logger to check that it works.

A name search for ZipTip in the computer magazine database on Compuserve got no hits — good.

Since I didn't actually download any magazine articles, the entire name search only cost 75 cents. To use this database containing articles in many computer related magazine, type GO COMPDB from any Compuserve prompt.

I start on the press release, and also do four hours of unrelated consulting work.

No one has responded to my request for beta testers — a bad sign?

Tuesday, Nov. 22

I finish the first draft of my press release.

I get a Nolo Press book on trademarking and trademark searches (see Resources, below). I'd used this book before, but needed a refresher course. Using it for guidance, I do a trademark search, again using Compuserve.

The only hit was some plumbing product (a different industry), so I knew that at least no one else has registered the trademark "ZipTip." Based on the magazine article and trademark search, I decide to go ahead with this name. Total Charges: $11.00.

Wednesday, Nov. 23

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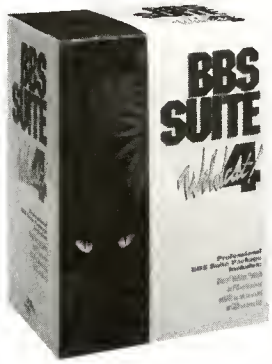

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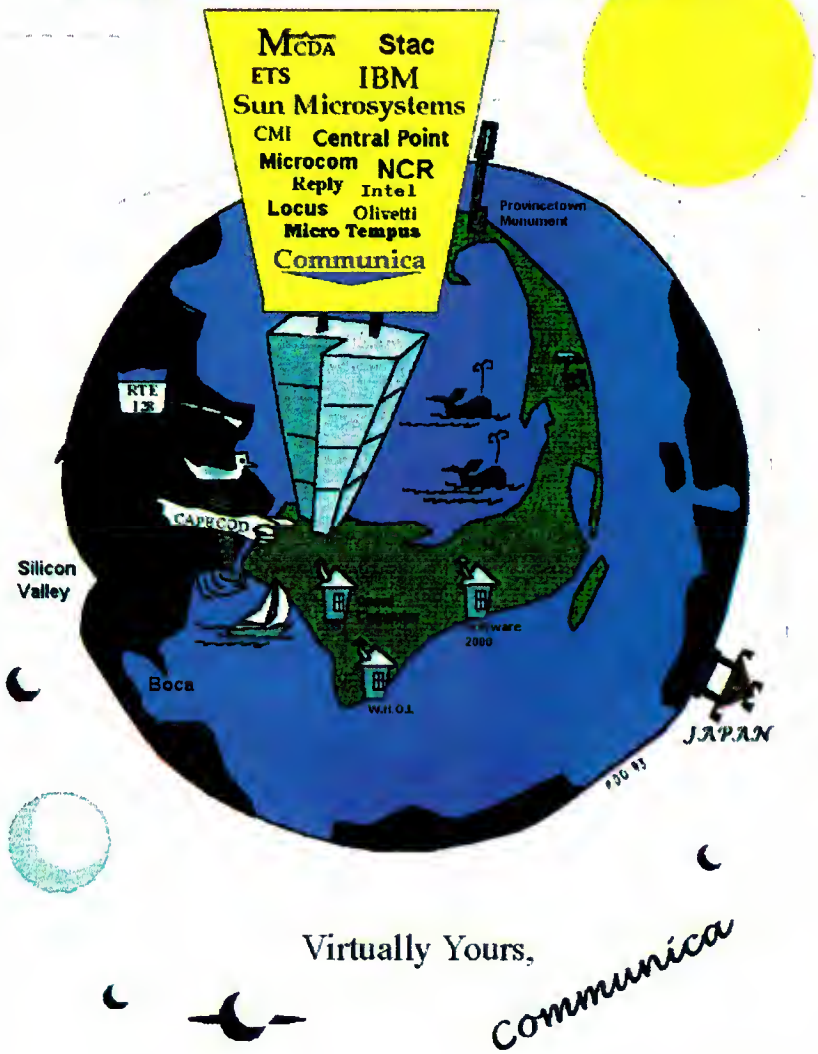

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Reader Service Number 30

I add miscellaneous features, such as a Help button (so that the user can get help on using ZipTip, and the developer can hook the Tip of the Day dialog's help button into an application).

Nov. 24 - Nov. 27

Thanksgiving weekend, family visiting.

Nov. 28 - Nov. 29

I create a 16-bit version of ZipTip. I had made a mistake in doing the 32-bit version first. It was more difficult to go backwards to 16 bit than it would have been to go from 16 to 32.

The beta test versions are sent to the testers (8 testers signed up, one in Germany), and testing begins. Eight testers may not seem like a lot, but remember that ZipTip is a very simple application — not that many "moving parts."

Wednesday, Nov. 30

I create sample code which demonstrates how to use ZipTip, and which will be included with the product.

Dec. 1 - Dec. 2

I write and debug the ZipTip Online User's Guide. This is a hypertext Windows help document put together using Wextech's Doc-To-Help program. Again, on this second time around, I was already familiar with Doc-To-Help, having used it for the Time Logger manual and help. Thus I avoided any research on what product to use, and required no time for learning the product.

Tuesday, Dec. 6

I design a simple diskette label using Word for Windows and Microsoft Draw, using the basic design from the Time Logger Label (which was created by a graphic artist), and modified it for ZipTip. Here's what it looks like:

I fax a copy to my label printer and get an estimate: Plate Charge $40, print 1000 labels: $140, and for 2000 labels: $167. I mail the artwork, and place an order for 1000 labels. I know, it was

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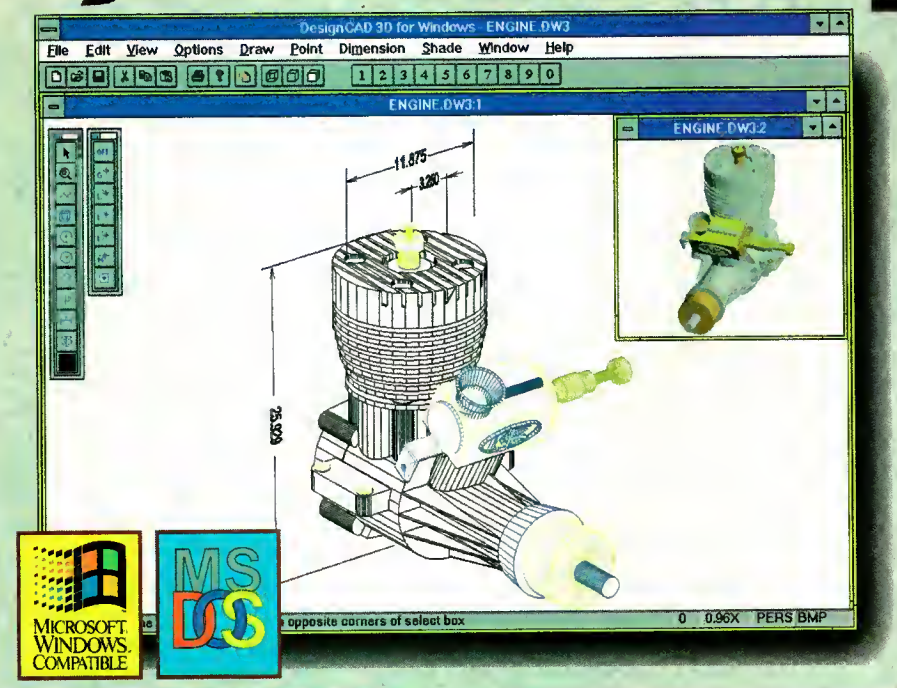

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only $20 more for an additional 1000 labels, but I'm trying to save every penny. If I sell 1000 ZipTip's, I figure I can afford the extra expense of a second printing.

Dec. 7 - Dec. 8

After getting quotes from the printer who did my Time Logger manual, I decide to do a one-sheet tri-fold manual for ZipTip instead of a 20-page book that would simply duplicate the contents of the Online User's Guide. I find some semi-gloss paper that will work in my laser printer, and use Word for Windows to create the brief instruction manual. The beta testers told me that they thought customers would be satisfied with a one-page manual and an Online User's Guide.

Friday, Dec. 9

I finish version 1 of the press release. I had a mailing list of about 800 computer magazine editors which I had purchased months ago for a release concerning Time Logger, but which I had not used. I went through these, and marked which magazines were appropriate. I found I could save a lot by eliminating publications which were not relevant (e.g., Publications for mainframe database users, graphic artists, etc.). It might have been a good idea to splurge for a more up to date list. About 10% of the releases I mailed came back as undeliverable.

Dec. 12 - Dec. 13

I finish work on the press releases, print them up on the laser printer, and mail them out.

Thursday, Dec. 15

I create a demo version of ZipTip, and upload it to Compuserve Forums (e.g., MSLANG) and an Internet FTP site (oak.oakland.edu). I've found this is a good way of getting free publicity. Potential customers can try out the product ahead of time. The demo version of ZipTip is just like the release version, except that only 25 tips may be entered.

I also put information about ZipTip on our World Wide Web home page (http://www.holonet.net/responsive). Finally, I add a new feature requested by a beta tester, and work on the one-page manual.

Friday, Dec. 16

Completed the short hardcopy manual. The finished diskette labels arrive. Started work on the license agreements to be signed by users who will be distributing ZipTip with their application.

Thursday, Dec. 22

I receive my first order for ZipTip and ship it out.

Thursday, March 9 - Postmortem

It's now almost three months since ZipTip was launched. How did it do? Well, I've sold only 14 copies so far, which gives a gross margin of around $720. The source of those orders breaks down to 5 orders from customers who saw the demo on Compuserve or the Internet, 4 orders via a product mention in VB Tech Journal, and 5 orders for which the source is unknown.

Was it worth it? It's too early to say yet. But remember that I needed to write and debug the code anyway for my other product, and that my expenditures were very low. The pace of orders is picking

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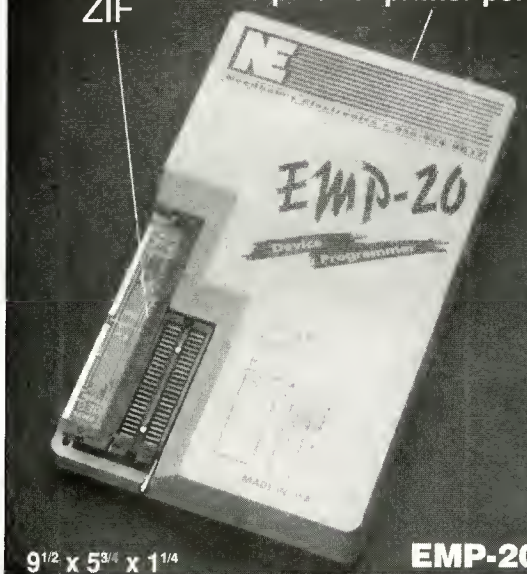

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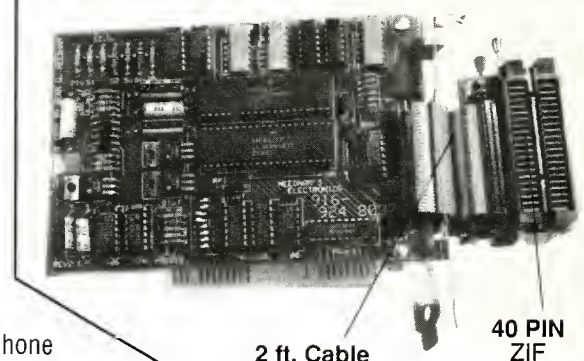

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Reader Service Number 95

up, and the customers have been very happy with the product. I have some other ideas for marketing ZipTip that may help me get more exposure.

Benefits of Selling More Than One Product

Besides giving your company an air of legitimacy, having a second product to sell lets you "cross market." For example, with every ZipTip I sell, I will include a brochure about Time Logger and vice versa. Thus I am getting a chance to mail literature to a qualified potential customer for free!

Finally, once your customers find out that you offer good quality products, and provide superior customer service, they are much more likely to buy from you in the future. If you only have one product, all of that good will is wasted.

I was lucky to come across an idea for a new product that could be developed so quickly. As I worked on it I discovered that the time and money needed to launch a second product is a fraction of that required for product number one. Not only can you avoid the mistakes you made the first time around, but you can use the supplies, equipment, and other infrastructure that is already in place.

Resource List

Doc-To-Help Windows Help Authoring System. Wex-Tech Systems, Inc. 310 Madison Ave, Suite 905, New York, NY 10017. 212-949-9595.

DP Directory - Mailing Lists of Computer-Oriented Magazines (for press releases). 525 Goodale Hill Road, Glastonbury, CT 06033. 203-659-1065.

Glossy Paper that Works in a Laser Printer: Scott SpectraTech Gloss (from the Scott Paper company, available at paper supply stores).

McGrath, Kate, Stephen Elias and Sarah Shena . TRADEMARK: How to Name Your Business and Product Berkeley: Nolo Press (510-704-2248), 1992.

San Jose Label (Contact: Linda Kaye) 1920 Hartog Dr. San Jose, CA 95131. 408-436-8221.

WISE Installation System. For creating Windows Setup scripts - Highly Recommended. Great Lakes Business Solutions, Inc. 39905 Lotzford, Suite 200, Canton, MI 48187. 800-554-8565.

ME

Alan Macy runs Responsive Software, a one-person business which develops and markets Responsive Time Logger, a Windows time tracking and reporting application, and ZipTip for Windows. He may be reached at 510-843-1034 or 800-669-4611, faxed at 510-644-1013, or e-mailed at Compuserve address 76367,3673. His mailing address is Responsive Software, 1901 Tunnel Rd., Berkeley, CA 94705.

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Liquid Crystal Displays

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20 character x 16 line $79.00 or 2 for $149.00

Mfr.: Toshiba TLX-1013-EO. *Unit is EL back-lit. Dim: 5 1/16" L x 4 1/16" H. The built-in controller allows you to do text and graphics*

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5V power required • Built-in C-MOS LCD driver & controller • Easy "Microprocessor" interface • 98 ASCII character generator • *Certain modules are backlit, call for more info.*

Graphics and alphanumeric—serial interface

size	mfr.	price	size	mfr.	price
640x480	Epson	$50.00	480x128	Hitachi	$15.00
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640x200	Toshiba	$19.00	240x128 (backlit)	Optrex	$20.00
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LASER DIODE: **Sharp part#: LT022MC**
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Hacker Corner

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These transceivers were designed for operation in an AMPS (Advanced Mobile Phone Service) cell site. The 20 MHz bandwidth of the transceiver allows it to operate on all 666 channels allocated. The transmit channels are 870.030–889.980 MHz with the receive channels 45 MHz below those frequencies. A digital synthesizer is utilized to generate the selected frequency. Each unit contains two independent receivers to demodulate voice and data with a Receive Signal Strength Indicator (RSSI) circuit to select the one with the best signal strength. The transmitter provides a 1.5 watt modulated signal to drive an external power amplifier. Channel selection is accomplished with a 10 bit binary input via a connector on the back panel. Other interface requirements for operation are 28 VDC (unregulated) and an 18.990 MHz reference frequency for the digital synthesizer. The units contain independent boards for receivers, exciter, synthesizer, tunable front end, and interface assembly (which includes power supplies and voltage-controlled oscillator). Service manual, schematics and circuit descriptions are available.

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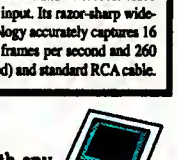
Portable Micro Terminal



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19	44	69	94	119	144
20	45	70	95	120	145
21	46	71	96	121	146
22	47	72	97	122	147
23	48	73	98	123	148
24	49	74	99	124	149
25	50	75	100	125	150

Evolutionary Development

by Jim Dawson

Longtime *ME* readers have enjoyed and learned from the many adventures related by the entrepreneur types whose stories fill these pages. I — my company — recently emerged from our own "project from hell" which may be of interest at some later date... Right now, I'd like to tell about a somewhat more successful venture: the development and evolution of a CAD driven, PC based x-y profiler.

While I design and work with all kinds of industrial controls, much of my work involves control systems using PCs running DOS as the primary control platform.

About five years ago I was still at my first business location, doing mostly custom controllers on PC platforms. I had developed a habit of always listening to a salesman's complete pitch and in general being nice to them. (Sometimes hard for an engineer to do). I was getting part of my work from their referrals, because they would remember what I did when they called on their other customers.

This particular salesman had called on Western Insulfoam, an EPS (expanded poly-styrofoam) products company. They had a profiler (hot wire process) for cutting architectural shapes from styrofoam and were looking to automate the process. The machine used a tracer eye technique to follow a full-sized pattern that was taped to a large board on the side of the machine. Drawings were done by hand and often required the draftsman or machine operator to put special marks on the drawing at corners and tight curves in order for the tracer eye to correctly reproduce the profile in the styrofoam.

Would I Be Interested?

I received a call from the machine operator (and future employee — another story). Would I be interested in automating their profiler machine? Over breakfast he outlined his ideas.

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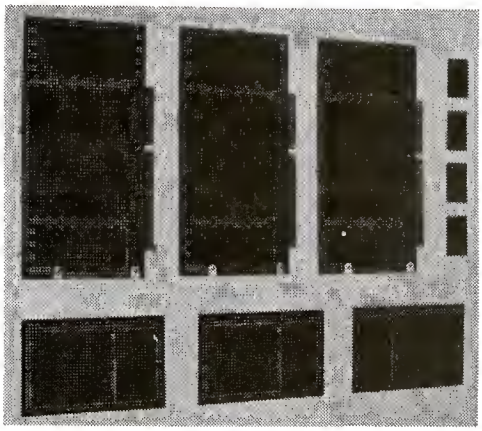

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Reader Service Number 6

what he was looking for, and set up a meeting with his boss and the guy who writes the checks.

At the meeting I learned that the manufacturer of the existing machine could provide them with a retro-fit controller — as could other controls manufacturers — but they all used older technology which stored patterns on paper or mylar tape, required a large training investment, and cost $30 - $60K.

At about this time Western Insulfoam had decided to use AutoCAD running on PCs as the in-house drafting standard for their sales staff and for interfacing with their customers — architects and commercial display designers. "Would it be possible and how much would it cost, they wondered, to put together a PC based controller that could run AutoCAD and convert the AutoCAD output to some form that could also run the profiler?" "Definitely possible," was my reply. I had just completed a PC-based 5-axis milling machine controller. "And probably for under $20K. Give me a day or so to give you a firm price."

The only items I wasn't sure of were the servo card and the software to do the conversion from the AutoCAD .DXF output files. Some calls to my suppliers turned up a PC based 2-axis servo card and an over-priced software package to convert DXF files to a format that would run on their indexer. Good enough. I came up with a price of about $15K for one unit and $11K each for three units. They would supply the PCs.

I got a down payment of $5,000 which covered the parts for the first unit and proceeded with the design.

Version 1 - The Pancake You Throw Away

The PC they provided was a 286 NEC clone using AutoCAD Version 10. I designed an auxiliary enclosure to hold the electrical components (drive amplifiers, power supply, etc) to connect the computer to the profile machine. This and the computer were placed in a small room near the machine. Since they wanted to retain the capability of running the existing tracer-eye controller I also had to include a junction box on the machine with a couple of relays inside to allow the motors to be switched between the two controllers. A small hand pendant at the machine (controlled via the computer printer port) allowed the operator to set-up and run the machine without running back and forth to the computer room.

Since the machine was 4-5 years old I couldn't find an encoder that would fit on the existing motors and the servo card required a quadrature encoder for feedback. A few calls turned up a motor/tach/encoder combination that would work with only a slight modification to the motor mounting brackets. The new motors were installed and tested with the existing controller.

With the electrical and mechanical design and modifications out of the way I proceeded with the task of writing the software to run the machine. About three weeks of hacking in Turbo Pascal version 5.0 and I had a system that could read and execute the text command files created by the CAD conversion package. We were one of the first users of this package and went through at least three updates before it could convert the 2-D patterns without a hitch.

Although a little cumbersome on the CAD conversion end, the package worked well and the customer was happy. Within a short time the tracer eye was completely removed from the machine and $6 - $7 per hour trainees could run the machine on second shift. But as with many new things the learning curve was traversed quickly and in about 6 months they were asking for more. More systems, but with modifications.

Version 2 - Almost There

"You know, the system works great, but is there some way we can do our drawings and run the profiler at the same time?" Once the system was working and productive it became obvious that the cutting machine needed to be available full time, especially for long production runs. Multi-tasking the CAD program and the machine program was considered but any slight delays accessing the motors would mean styrofoam meltdown. PCs were getting cheaper anyway so it was simpler to put the control computer on the machine which also had the benefit of getting rid of the large bundle of cables and wires running from the control room to the machine. All we would need was a communications cable to get files to the machine.

The biggest problem was the location available for mounting the controller on the machine. It would require an enclosure about 4" deep and there were no standard PCs that would fit. I settled on a small, single board PC/XT product and after a considerable amount of head scratching got the complete controller into a 16" x 24" x 4" box. In order to install the servo

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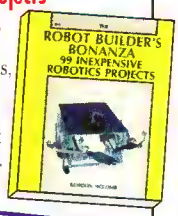

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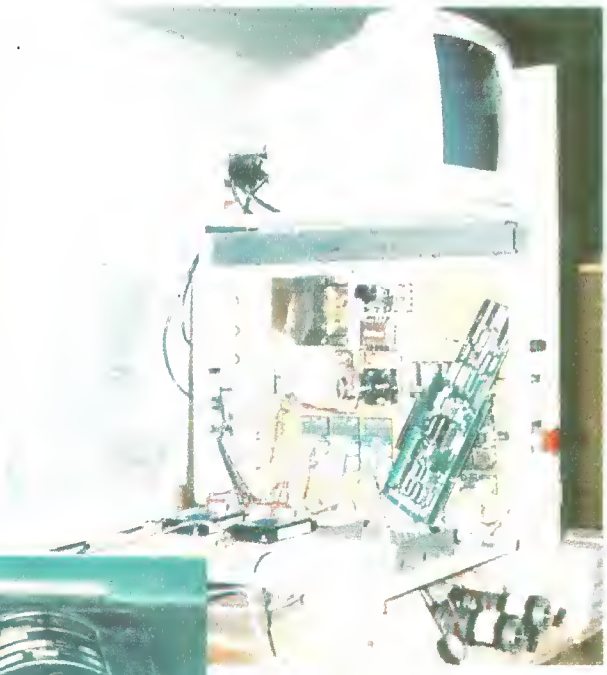
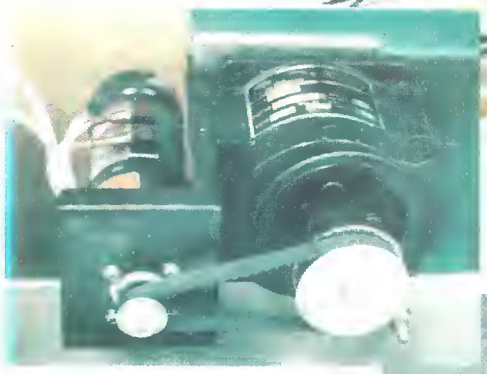
board I needed a special adaptor and a DC/DC converter to generate +/- 12V for the indexer card. The computer ran DR-DOS and thus was not directly compatible with the MS-DOS CAD system. (This wasn't a problem except when you needed to update the controller program in the field or needed to make a boot disk.)



The new controller required only a day or so to install and worked as well as the original design. I did have some timing problems with the indexer since the XT was slower than the AT it had previously been running on. We used an RS232 link to transfer the patterns to the machine computer.

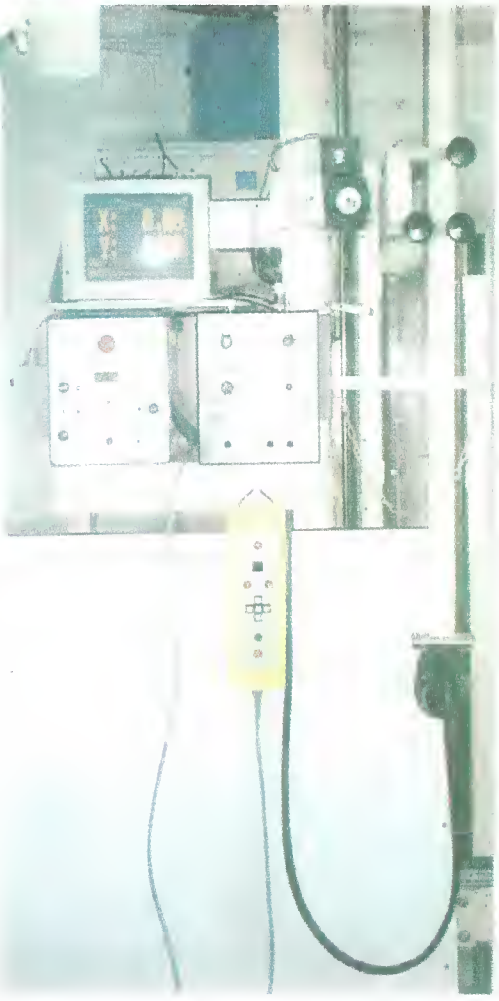


By this time I had also written a CAD conversion utility which did a much faster job of converting the AutoCAD patterns into text command files.

After replacing the original controller, the second controller was installed at their facility in The Dalles, Oregon which was a little further from home base. This machine had a different motor/gearbox configuration so we had to provide new gearboxes on both axes. Once we solved the mechanical problems the machine operated very well.

The problems encountered during this startup indicated that it would be better if the machine controller were also MS-DOS based. We also found a better location on the machine to mount the controller cabinet and monitor which eased the size restrictions of the controller cabinet.

This version was kind of a step backwards. It cost more since it was a speciality product and required lots



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of adaptors to plug in standard PC boards. I also had to run from a floppy drive since the computer manufacturer didn't yet have a hard drive interface I could use.

Version 3 - It Just Feels Right

The third time is a charm. With the new mounting location on the machine, we were able to re-package the controller into a taller box which allowed us to use our newly developed J-BoxPC chassis in the design. It used a readily available 3/4-length 386 mainboard running standard MS-DOS, a low power 2.5" IDE hard drive, and a standard local area network (LAN) card to connect the controller to the CAD system. We now had a system that could make use of off-the-shelf PC hardware creating a powerful, low cost controller and making long term maintenance easier and more affordable for the end user. It also allowed the CAD operator to remain in the front office (where he wanted to be anyway) with each profile machine appearing as another drive on his CAD computer.

This third system was installed in Dixon, CA which required air travel to the site. It was very important that the system work reliably and be easy to maintain since there wasn't much budget to fix things if they went wrong.

We are now in the process of installing our controllers on all the profilers this company owns. Each system requires 1 day to install (we do it without stopping production — very important for companies large or small), and comes with three days of CAD training.

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I now use the J-BoxPC chassis exclusively in building and maintaining PC-based controllers for a variety of industrial environments while using off-the-shelf, commercial grade PC components.

Note: The two Version 2 profiler controllers are still in operation (about 4 years - I think) but will soon be up-graded to our current model which uses the latest version of our J-BoxPC industrial computer.

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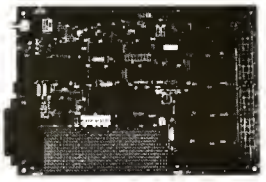

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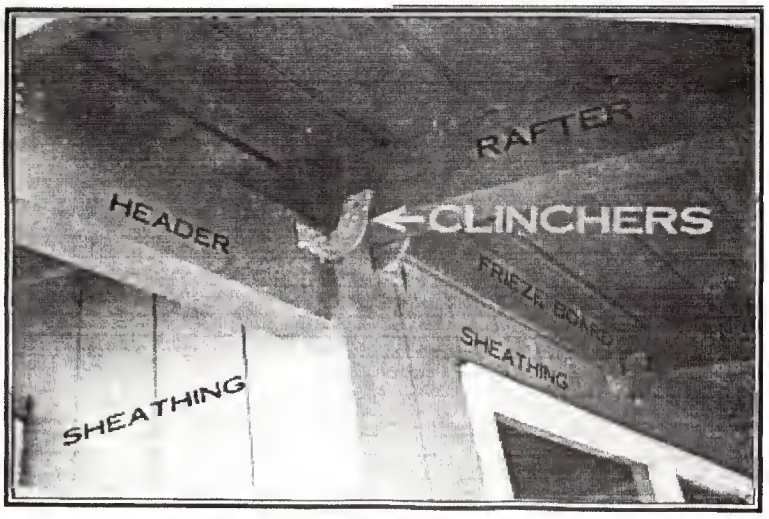
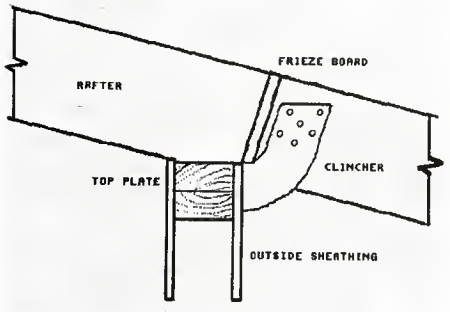


The man with a new idea is a crank, until the idea succeeds.
— Mark Twain

by John R. Thompson

November 1982 — Hurricane Iwa struck the Hawaiian island of Kauai with wind gusts over 100 mph. Kauai is about 100 miles west of Honolulu on the island of Oahu. My brother Tom was in his house at Makakilo, on the southwest part of Oahu, trying to keep the wind-driven rain from coming through his jalousie windows. During one particular strong gust of wind, the corner of his roof lifted up and he could see gray sky between his walls and roof. If the wind gust had been any stronger, the entire roof would have been torn from his house.

Needless to say, Tom was alarmed. Faced with immanent danger and destruction, he quickly nailed a metal band between the exposed rafter and top of the wall in the corner of his house. There



were no more strong gusts of wind during the hurricane, but Tom did not understand how his house could be damaged by a hurricane whose eye was almost 150 miles to the west.

Wind gusts measured at Honolulu International Airport during the hurricane were about 60 mph. How could this relatively weak wind almost rip the roof off his house? After the hurricane, Tom decided to see why his house was almost destroyed. All the houses in his area are of similar construction and age, but none of his neighbors experienced any damage.

Most older homes in Hawaii are constructed of plank-and-beam (single wall) wood framing. These homes develop structural stability by concentrating roof loads on a few large beams which in turn transfer their loads directly to the foundation by the use of posts and columns.

A thick continuous header is used at the top of the outside walls, carrying the roof weight from the rafter beams to the wall posts. The walls are braced by thick outside sheathing. This construction creates a large, open space with exposed rafters and wall posts. Some owners put up wall board to cover the beams, but many leave them exposed.

Tom noticed some problems right away. Since there is no frost in Hawaii, houses do not need a deep foundation. In fact, most of the houses have their posts set on top of a small cement block in the shape of tofu. This "tofu" block sits on or just under the soil. The house uses its weight to stay in place, but is not resistant to being lifted off the block due to wind loads.

Oahu was created by ancient volcanos, and two mountain ranges form most of the island. Many of the sugar cane and pineapple fields are on the flat parts of the island and numerous homes are built on slopes. Tom's house is on a slope with the rear of the house on the ground and the front raised on posts. This affords beautiful views of the ocean and mountains, but the slope provides a Venturi effect where wind along the ground must speed up to join wind in the air.

Tom's house faces south, the same direction that hurricanes approach from the warm waters of the Pacific Ocean. His house is also raised up slightly higher than surrounding homes in order to provide views of the ocean and Diamond Head to the east. This combination of height, mountain slope, and south-facing exposure, makes his house very susceptible to strong winds.

Many of the houses in Hawaii are constructed to take advantage of the constant trade winds and to block out heat from the tropical sun. Air conditioning is very expensive, hence the houses contain jalousie windows (like a Venetian blind) that can remain open all the time, yet keep out the rain. These type of windows have many panes of glass and sometimes leak air when closed; they are seldom used in areas that have cold weather.

The roofs are built with long overhangs or eaves to keep the direct rays of the sun out of the house. This works very well for that purpose, but the eaves act like a wing when strong winds hit from the side. The wind forms a low pressure on the top of the roof, and a positive pressure or very strong uplift under the eaves. When wind enters the house through a broken window or patio door, it increases the positive pressure acting on the underside of the roof. If this pressure exceeds the weight of the roof and the strength of the attaching nails, the roof separates from the house.

Each rafter beam, which holds all the weigh of the roof, is connected to the wall beams by two nails. Toenailing, a process of nailing at a 45 degree angle from either side, is used to attach the rafter to the wall. This toenail connection is weak when subjected to uplifting

forces, because the force is almost parallel to the nail direction.

In order to counteract uplifting forces, metal hurricane clips were invented. The shape is different for each clip, but the function is the same. After the rafter is toenailed to the wall, a hurricane clip is nailed to the rafter and top plate of the wall. The nails attaching the clip are perpendicular to uplifting forces and would have to be sheared in order to yield.

Hurricane clips are available at every hardware store in Hawaii as they are required on new houses built since 1988. I don't think Tom was the first to try and install hurricane clips on his house, or the first to notice that the hurricane clips won't fit on existing homes.

Available hurricane clips can only be installed when a building is under construction. When a building is completed, it is almost impossible to install a hurricane clip without demolition of the inside wallboard or outside frieze boards.

Having worked as an aircraft mechanic for over 20 years, Tom was familiar with quickly making repairs and crafting metal into unique shapes. He made some crude brackets to tie his roof down to the wall beams. They were not pretty, but they were hidden inside his house. He forgot about hurricanes until 1992.

Hurricanes are not common to Hawaii, but in 1992, Hurricane Iniki struck the island of Kauai. This hurricane did not receive much press because it struck soon after Hurricane Andrew devastated south Florida. Hurricane Iniki caused extensive damage to Kauai, but had no affect on Oahu. When Tom saw all the damage that had been done to houses in Kauai and Florida, he decided that he could make a hurricane clip that could prevent much of this destruction to older homes.

Since most of his neighbors have gypsum walls in their homes Tom decided that his hurricane clip should go on the outside of houses. This would later be shown as an act of brilliance because Tom found out that homeowners do not want a stranger working in their house and do not want to see metal straps. He also found out that attaching a hurricane clip to the outside of an existing house makes the exterior sheathing a structural member, tieing together the roof, walls, and floor.

Tom starting crafting a bracket that would tie together the rafter and top plate of the wall, while also clearing the frieze board, tie in the outside sheathing, and not be too noticeable. Nobody would want to buy his hurricane clips if they were hard to install, expensive, or ugly.

Tom wanted a hurricane clip that was unique; able to be attached to either side of a rafter and capable of being underneath it. After Tom welded, bent, and cut material, he perfected his design and gave me a call.

Tom is seven years older than I and had to take care of me when both our parents were working. Although it was fun to be with "older" kids then, I knew that my brother wasn't thrilled with

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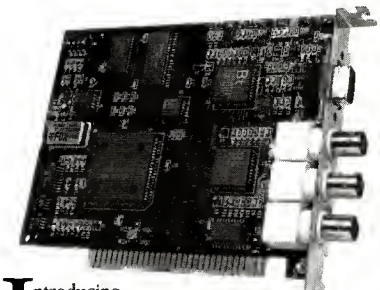

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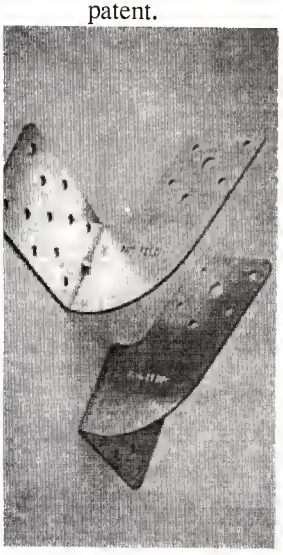
Reader Service Number 134

dragging around his kid brother when he was with his friends. I was lucky to experience growing up "twice," once in my brothers youth and again in my own youth. With our age difference, dissimilar friends, and distinct viewpoints, we went our separate ways.

I had worked in mining, geology, and mineral exploration in the western U.S. for over 16 years, and had just recently been laid off. I had written many scientific reports, but when Tom explained his design to me over the phone, I understood very little. With the difference in construction of my brick house in Colorado and his wood house in the tropics, I could not figure out how his hurricane clip worked.

Even when he sent a drawing of his hurricane clip, I could not fathom how wind could lift a roof off a building, or how a clip could prevent it. Then again, I couldn't comprehend how a large 747 could get airborne. Frustrated, my brother explained that he wanted to patent his invention and he wanted my help in the writing process.

After acquiring Pressman's *Patent It Yourself* book from the library, I started the patent search. I saw how other patents were written and that none of them were similar to Tom's hurricane clip. Since I hadn't seen my brother in eight years, I decided to visit him in Hawaii and work together on his patent.



In January 1994, we joined forces after months of communicating via phone and fax. After seeing his previous prototypes and how his hurricane clip fit, we got started on the patent. Tom would draft the drawings while I would write the specifications and legal claims. This would be a little hard to do since Tom did not have a computer and neither did any of his friends or neighbors. I commenced writing (literally) the patent.

We worked well together. Our strengths and weaknesses complimented and balanced each other. I looked up an old friend that had moved to Hawaii and she agreed to transfer my writting to a word processing format. After brainstorming together with my brother, we came up with new ideas for the patent, as well as novel inventions related to hurricane damage prevention and solar energy. We completed the patent application in three weeks.

In the future issue, I will discuss our dealings with Insurance Companies, Architects, Federal Emergency Management Agency (FEMA), Universities, Civil Defense, and other "experts."

ME

John Thompson is an ex-geologist from Denver, CO. He and his brother Thomas formed No Worryes Hawaiian Hurricane Clinchers, *92-543 Kokole Pl, Makakilo, HI 96707*

Note: Part II (developing, testing, producing and marketing low tech products) and Part III (trade shows and the patent) will be in future issues of ME.

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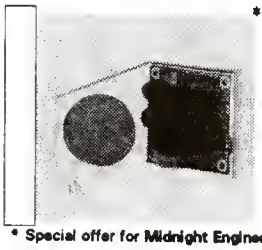

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GADGETS & GIZMOLOGY

by Gary W Funk
Gizmologist

MAXTOR'S MOBILEMAX DESKRUNNER

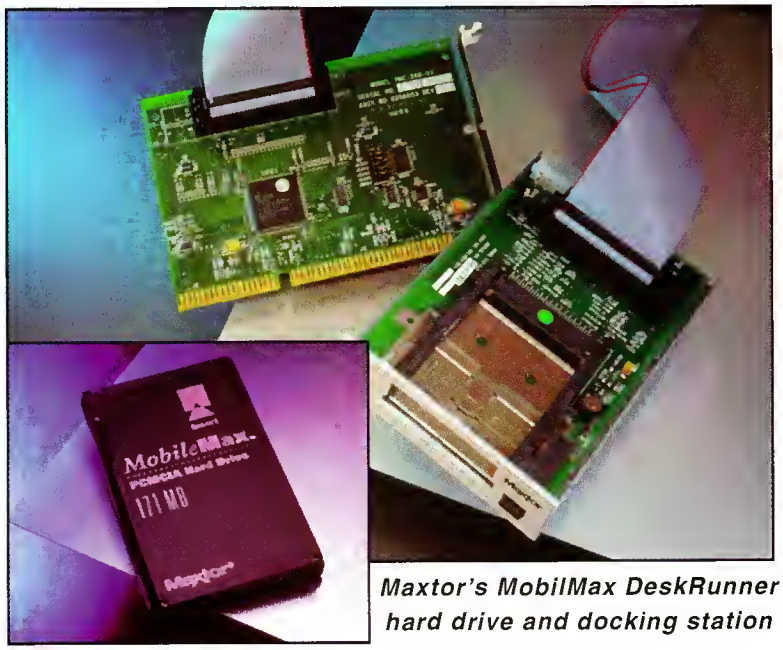
Plugging a computer seems to be the buzz word of the month. Computers want to be plugged into this thing, and plugged into that network. I've been there, done that, and got the t-shirt. On the other hand, plugging things into the computer can be as much fun if not more. A visit to a local computer store will show dozens of nifty gadgets that will enhance any computer system. One group of gadgets, that until this year was limited to notebooks, is the PCMCIA (PC Memory Card Industry Association) cards and adapters. If you own a notebook computer, it most likely has a PCMCIA slot in it. And if it does, it most likely has a PCMCIA card. And if it has a PCMCIA card, there might be a time when you want to use it on a desktop computer.

Maxtor Corporation, a leading manufacturer of hard drives, has developed a line of products they call MobileMax. One of these products is the DeskRunner PC Card Drive that allows you to add a PCMCIA slot to your desktop computer. It consists of an interface card that plugs into a 16 bit slot in the computer and a cardslot module that fits in a 3.5" or 5.25" drive bay, some mounting hardware, cables, and software to make it all work.

The DeskRunner supports PCMCIA Type I, II, and III cards and is fully compliant with the PCMCIA 2.1 protocol. It allows the use of PCMCIA network cards, modems, I/O cards, memory cards, and ATA 1.3" and 1.8" hard drives to be used on the desktop computer. It supports most card data formats including the True Flash File System and the Microsoft Flash File System.

DeskRunner also supports a feature called Hot Swap, which allows the insertion and removal of PCMCIA cards while the system is running. This lets the PCMCIA hard drive from a notebook computer plug into the desktop computer with no interruption. Changing PCMCIA cards is much like changing 3.5" floppy disks. If other computers have a DeskRunner installed, a single drive containing several megabytes of data can be moved from computer to computer to update files or continue work. An example would be if there is a document that is being worked on, the drive can be placed in the computer that has a scanner attached to it. The images can be scanned directly to the PCMCIA drive. The complete document can then be moved to another computer to free up the scanner and the work can continue.

Installing the DeskRunner is easy. Plug the cables from the interface card to the card module. Install the module in a drive bay, plug in the interface card, turn on the computer and run the install program. Reboot the computer to load the CardTalk drivers and plug in the PCMCIA card you want to use. You now have instant access to it to any PCMCIA card. The best reason for installing a DeskRunner on a desktop computer is to access PCMCIA hard drives.



Maxtor's MobilMax DeskRunner hard drive and docking station

Accessing a hard drive in the DeskRunner is just like accessing any other hard drive. It is assigned a drive letter on boot up and acts much like a floppy drive. The **config.sys** software drivers necessary to access the DeskRunner took up 56K of memory, leaving only 487K of base memory on my system. That's more than I want to part with as many programs want at least 512K free. But for access to a PCMCIA slot and removable hard drives, I will find a way to free more memory.

What moves this gadget to the top of my list is that this is also one of the best ways to transfer large files from one computer to another whether it is in the same office or a computer across town or in another country.

I tested the MobileMax 171MB hard drive in the DeskRunner. And although I have resisted the need to use my micro screwdriver set and open it up, I did give it a good workout. It does have two platters that rotate at a speed of 4464 rpm. With a 32KB cache it will do burst transfers of 7.5MB per second and a sustained data transfer rate of .5MB per second. It has an average seek time of 16ms and a track-to-track seek time of 4ms. In a real-time test of transfering files, it is almost as fast as the Maxtor 7345 I use.

If you want a new gadget to play with or if you have a notebook with a PCMCIA slot, run, don't walk to your nearest computer store. Get yourself a DeskRunner and MobileMax 171. This is the way to go. ◆

The Maxtor MobileMax DeskRunner PC Card Drive has a suggested price of **$102**.

The MobileMax PCMCIA Type III hard drives are **$306** for the 105MB, **$329** for the 131MB, and **$390** for 171MB.

A 262MB drive is to be released soon and the suggested price is to be determined but should be under **$600.**

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More Kitchen Sink Surface Mount

by Al McGilvra

Convection ovens can be modified for surface mount soldering with very good results. We bought a convection oven ($180) from a department store, built a simple temperature controller for it, and got results approaching those of a service bureau.

The components are placed on one or both sides and the board is placed in the oven. Once the start button is pressed you simply wait. When the preset temperature is reached the oven turns off. You open the door, wait a while, then remove the board.

The temperature versus time profile is close enough to commercial infrared reflow ovens, provided the oven is cooled to below 50 degrees C (120 degrees F) between batches. This can be accomplished by leaving the door open and fans running, with the heater coils off. The cooling is necessary so that the temperature can pass through the point needed to drive off solder paste solvents before the melting point (reflow) is reached. If the cycle does not include a minute or so at around 100 degrees C then the solvents are not sufficiently removed and poor solder joints can result.

The controller we built originally had four thermocouples so that we could monitor the four corners of a board to detect any serious temperature differentials. The maximum differential we observed was two degrees C, which is negligible. As a result, only one thermocouple is actually necessary. When you press the start button, the controller turns on the coils, leaves them on until the thermocouple reaches the setpoint of 219 degrees C, then turns them off. The fans are blowing all the time. We could not use the temperature knob on the front panel of the oven because it has too loose a tolerance. Also, we needed the capability to turn off and leave off the coils once the thermocouple had come up to the setpoint. The thermocouple should be placed as near as possible to the surface of the board because it is the surface temperature that counts. The setpoint should be 219 degrees C (426 degrees F). If the setting is too high you will discolor the board and perhaps damage other components. If it is too low you will get solder bridges, especially between fine pitch leads.

Parts can be placed on both sides of the board. However, you will need some sort of standoffs to keep the bottom parts up off the oven rack. The solder paste is tacky enough to hold parts on the bottom in place through reflow. Some parts may be too heavy and fall off, we didn't try any real big surface mount parts on the bottom. Chip resistors and capacitors are no problem.

Mildly activated solder paste should be used. Highly activated paste has more flux in it which is useful for old tarnished boards but leads to excess residue on the finished board. On the other hand, if the paste doesn't have enough flux you will get poor solder joints. You can get the paste from vendors in syringe form. It must be stored in the refrigerator and even then its shelf life is limited to a few months so don't buy too much at once. Buy quality paste, don't cheap out here, the cost is well worth it. Although you can buy pneumatic equipment for dispensing the paste, it is expensive and not that controllable. For low quantity, the syringes

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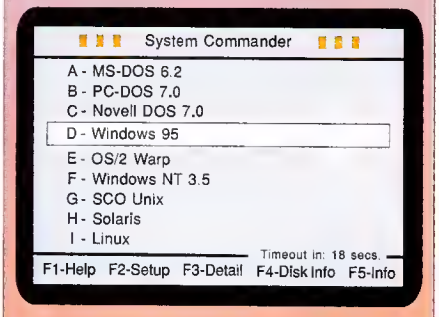
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work fine. You can also get glue in syringe form that will hold parts in place during processing. This may be useful for heavy parts on the bottom of the board, but is mostly detrimental because it prevents the self alignment that occurs with solder paste only.

The surface tension of the molten solder will center and align parts on their pads. This means you don't have to do perfect placement. Just get the leads on ICs close enough so they don't align to an adjacent pad. Fine pitch J-leaded ICs can be notorious for invisible solder bridges. The key here is not to use too much paste. Also, make sure the oven gets hot enough. Fine pitch gull-wing ICs can also bridge but at least you can see the bridges. If your brave you can run a bead of solder right down a row of pads. The theory goes: the surface tension will cause the paste to separate onto each pad when it melts. We've tried it with mixed success. I do not recommend this practice on J-leaded ICs. The recommended practice is to place a small amount on each pad towards the outside edge (away from the IC center). Experiment with different amounts and placements before you do a whole board.

You can also use the oven for de-soldering. As soon as the reflow temperature is reached, open the door and give the board a good whack with something. All of the components on the downward facing surface will be removed. Of course, you will have solder bits all over your oven after this, but it is effective for mass de-soldering. Why would you ever want to

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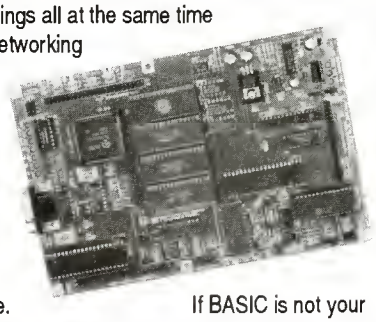

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do mass-desoldering? I don't recall why we did, but I'm sure there was a good reason at the time.

We've found that theconvection oven can be used to achieve "near-bureau" surface mount soldering results for prototypes. It can also be used for low quantity production. Batches can be run if the boards aren't too large. The temperature controller design is available from McGilvra Engineering. It should be noted that this approach is probably not the best for very early prototyping and low density boards. Special soldering irons and tips can be purchased for hand soldering and we've done this with acceptable results. Once a PC board is made however, the convection oven gives superior results and is faster, especially for high density boards.

ME

Al McGilvra can be reached at McGilvra Engineering, 808 Lowell, Jackson, Michigan, 49202, 517-783-2623, FAX 517-783-0676, or e-mail mcgilvra@voyager.net. He holds an MSEE and has over 12 years experience designing electronics and leading projects. McGilvra Engineering is an electronics design firm specializing in custom instrumentation and control, high-performance analog interfacing, and fuzzy-logic controllers.

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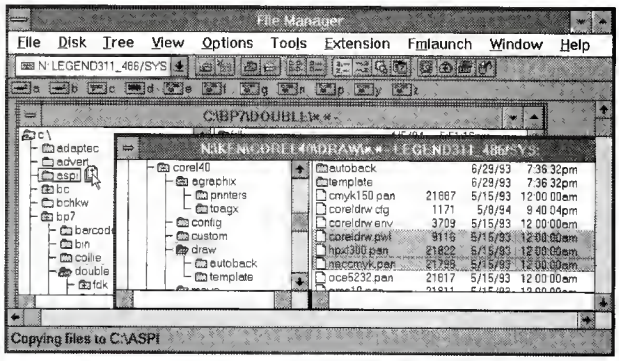

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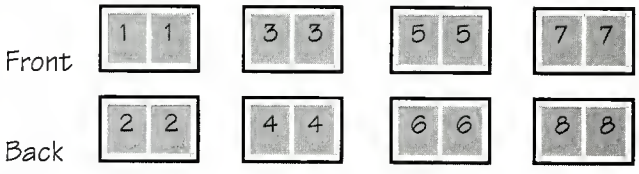

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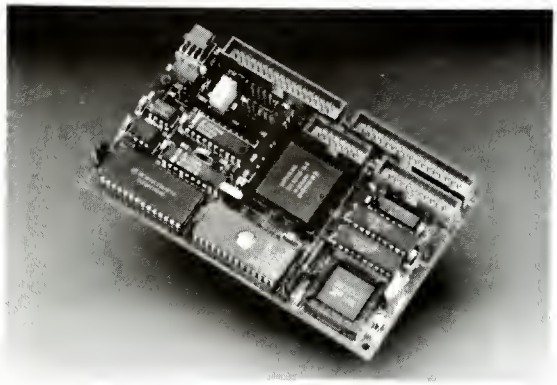

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Your budget is tight.

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On the bench is your breadboard, covered with IC's, capacitors, resistors, inductors, power FET's connectors, cables, sensors, knobs, buttons, LED's, readouts and readins.

The sparks in the Jacob's Ladder undulate as they rise toward the vaulted ceiling. The rumble of the last thunderbolt still echos through the castle. The creature on the next table has just opened its eyes...

INSERT PHOTO OF KLUDGE CHASSIS HERE

The chassis is made from an old orange crate; it is held together with bailing wire and bubble gum. Electronic components seem to be leaking out from between the ill-fitted slats. Suddenly, a gnarled arm breaks out of the box and reaches toward you...

A standard blank box would be quick and cheap, but its a pain to design and cut all the holes. And no matter how careful you are, it won't look "finished". And when you count your time and effort, you haven't saved that much after all.

A start-from-scratch custom design will have just the look and feel you want. But the design is still a hassle, it will cost a fortune, and it will take forever.

INSERT PHOTO OF SLEEK CUSTOM CHASSIS HERE

This chassis is made of machined stainless 304, with a gold-iridite finish. The edges are carefully radiused. The front panel surface is a compound curve that seems, somehow, soothing. Each control and indicator has an engraved legend, inlaid with iridium. There is a hum of controlled power. Your boss has just staggered into the room, gasping for air and clutching a handfull of invoices...

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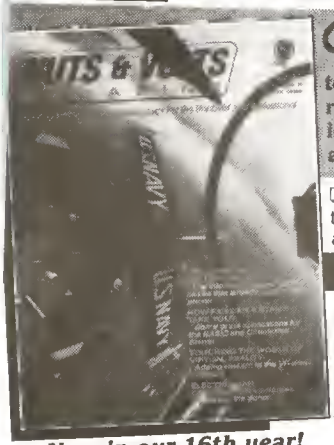

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Derivative Products

by Jack Krupansky

Whether your product is a success or a failure, sooner or later you need follow it up with another product. Maybe a competitor moves in or maybe the market moves on. Somebody changes the rules of the game and now you need to respond. You can start from scratch on a new product or you can revamp your existing product. It's fun and exciting to start over, but you might be much better off salvaging and leveraging your past efforts. A technologist will prefer to start with a clean slate, but an entrepreneur wants a head start.

Some of the more successful companies got there by taking a product and enhancing it to get a new product. This new product is called a derivative product since it is derived from an existing product. The derivative product might be radically different or it might be an incremental improvement. A slow but steady stream of incremental derivative products is a less risky route to success than to dream of a string of back-to-back home runs. With significantly less effort invested in a derivative product, a failure can more easily be recovered from.

You can also ***use a derivative product to experiment and test the waters for a new market.*** Your existing customers can be beta testers. Take the opportunity to slightly change your focus and maybe you can identify a larger or more accessible market.

I decided to write this article after I successfully released a new product, CodeScript, which was based on my current product, Liana. It is a callable, C-like, object-oriented programming language interpreter for C/C++ Windows programmers. The bulk of the product is a subset of Liana, but with a few key features and packaging that make it more appealing to a broader market.

From an intellectual property point of view we get the concept of a derivative work. This is a work (or product) that is produced by modifying an existing work. Those modifications might involve adding new elements, removing existing elements, or transforming existing elements. An example of the latter would be a foreign language version of a product.

At a trivial level, most products can be considered derivative because we almost always use some pre-existing, off-the-shelf components to which we add our own components and know-how. For example, C programmers utilize functions from the vender's runtime library or add-on libraries. Although the product is indeed derived from those components, it is the large amount of know-how that makes your product something more than just a raw collection of parts. In much the sense that a book is much more than being derived from a collection of words.

If your product can in turn be used as a component of larger products, those products have their own primary value. Your product may be the important tail of the dog, but the customer designed the dog itself.

Some good examples of derivative products are Adobe's Display PostScript derived from PostScript, Microsoft's Windows for Workgroups derived from Windows, Borland's Delphi derived from ObjectPascal which was in turn derived from TurboPascal, and Microsoft's Visual Basic derived from their BASIC efforts and an acquired GUI development environment. In each case, not only was the development time reduced, but the venders were able to capitalize on the market success of the original products.

I would not classify Microsoft Windows as being derived from MS-DOS since Windows merely uses DOS in much the same way as an application

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                                                ; set intrpt vector al to ds:dx
                mov   dx,offset data_4          ; ('Halt when ? printed.')
                mov   ah,9
                int   21h                       ; DOS Services  ah=function 09h
                                                ; display char string at ds:dx
                mov   dx,19h
                mov   ah,31h
                int                             ; DOS Services  ah=function 31h
                                                ; terminate and stay resident
                                                ; al=return code,dx=paragraphs
virustst        endp
;
;
;
int_17h_entry proc    far
                pushf                           ; Push flags
                cmp   al,3Fh                    ; '?'
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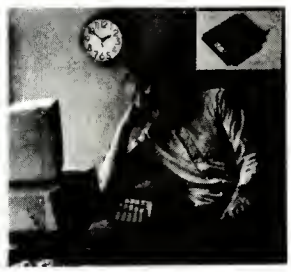

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uses DOS or Windows. Similarly, Windows NT is not derived from Windows since it was a from-scratch effort (although emulation of the Windows API and DOS are included) and the primary value is far more than the emulation of the older systems.

A product is the sum of its strengths and weaknesses. The price and market acceptance of a product will reflect the balance of those strengths and weaknesses. Remove some weaknesses or add some strengths and you may be able to boost the price. Or maybe you can strip out some of the strengths and sell at a lower price to a larger market.

Decide what you really want to get yourself into. Do you really want to deal with all the logistical hassles of higher volume? Might you prefer to deal with an even smaller customer base if they are more sophisticated and willing to pay a higher price for a more sophisticated product? Do you enjoy customer support and interaction with sophisticated users? Maybe you'd rather just do a small utility and take a small royalty in return for somebody else doing all the marketing and support.

You might consider developing a product that is almost self-supporting . Actually, identify a market whose customers support each other. With the various on-line services this is now possible. Your full-blown product may require extensive support, but a stripped-down version (less room for the user to screw up) might be more profitable.

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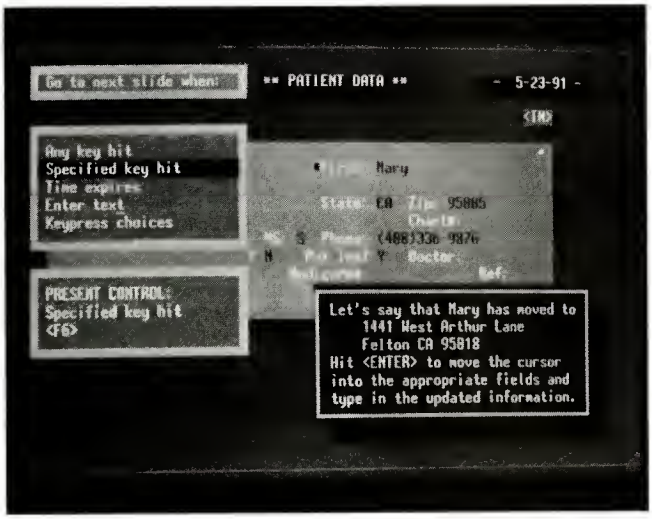

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The product is what the customer sees, not the technology. The technology is the raw material used to build the product. The more technology you have to play with, the wider your derivative options. If your product consists of mostly off-the-shelf components, you may not have too many derivative options and end up needing to start over to get your next product. But with a much higher proportion of malleable, proprietary technology you may have enough flexibility to generate all sorts of new products without starting over. Use your technology to give yourself more control over your destiny.

Although it is really a trivial example of a derivative product, ***a new release of your product with minor changes still qualifies as a derivative product.*** Maybe a few features makes your product more appealing or more competitive. Microsoft Windows 3.0 was just a new version of Windows 2.1, but with enough new features that the market instantly began paying attention to what had been a real dog of a product.

A stripped down version of a complex product can frequently be more popular for cost-conscious and less sophisticated customers. Example are Novell Lite and PowerSoft's Desktop version of PowerBuilder.

Your product may run on DOS. It can be moved to Windows, Windows NT, OS/2, UNIX, the Macintosh, NeXTStep, etc. If the new platform is less capable or a wider market you might drop the price. Or if the platform is more capable or a

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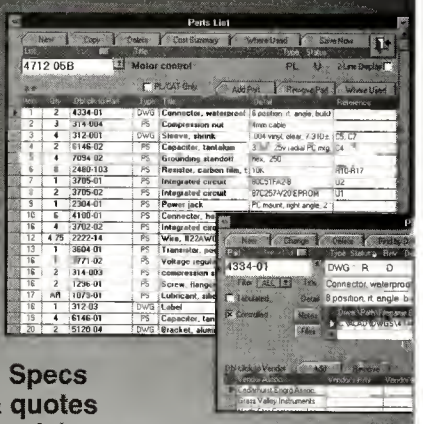

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more limited audience you might add some custom features and raise the price.

Sometimes you can succeed by ***adding tons of bells and whistles to your product***, but that approach frequently backfires. The product might become harder to use. Or customers resent paying extra for stuff they don't need. Or the product is slowed down. It gets bigger. It needs more disk space and takes longer to install. It takes more time and money to test it, not to mention to develop it. But even with all these possible downsides, sometimes it works. Windows 3.0 is a good example.

Bundling: By packaging several products together you can reinforce in the customer's mind the benefits of how the products work together. Maybe they hadn't thought very much about the synergism before the products were combined for them. Maybe they had worried that there might be interface problems with your product. Or maybe a price discount on the bundle makes all the difference in the world. Or maybe they wouldn't have bothered to buy your product by itself, but since it came with the other products they'll give it a try.

A lot of suites and bundles are just promotional with no real, substantial technical link between the products. I wouldn't consider them to be derivative products. But if your product is integrated with another product the customer may finally perceive a whole that is greater than the sum of its parts.

You don't even have to have a product to create a derivative product. You can license someone else's technology and use that as a base. Why would they let you and why wouldn't they do it themselves? Sometimes they don't have the resources or the niche for the derived product doesn't interest them. Or maybe they recognize your special skills and would be more than happy to take a cut of your pie without having to expend resources. The bottom line: it allows them to leverage their assets.

On the other side of the fence, maybe you have a successful product or technology that could be used by someone else to derive a new product that wouldn't directly compete with you but would allow you to enhance your income with minimal expenditure of resources. And let someone else take the market risk.

But think twice about how you provide access to your technology. A good partner can allow you to leverage your energy and assets. Don t let the grand and glorious promises of endless riches delude you into giving away the store. But don't cling to your property so tight that you miss your big opportunity.

I personally have been toying with the idea of ***releasing shareware versions*** of my products after they have been commercially released. My goal in doing that would be to reduce my presales overhead, especially requests for demo disks that I don't have. Let them try it out rather than listen to me tell them how good it's going to be. My biggest concern is that I'll not have as many leads and may end up needing to provide support for non-paying users.

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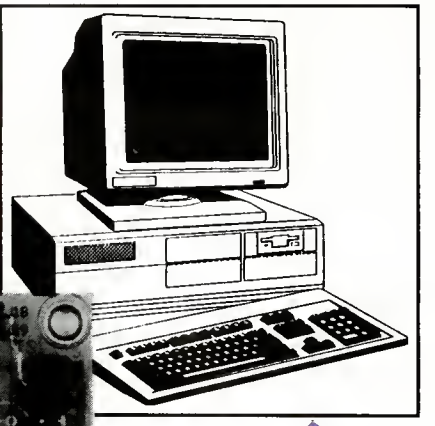

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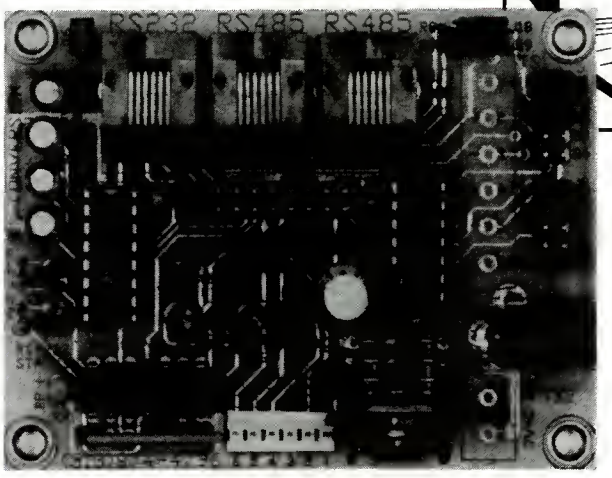

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I'm currently more comfortable using a $129 price to filter out all the low-lifes who are more interested in collecting demo disks and playing around than serious business.

The shareware version should be somewhere between a really stripped down demo/working model and the full-featured product. It shouldn't be too badly crippled and should allow the developer to realistically evaluate the product. Give them enough of a taste to whet their appetite.

This approach may get renewed interest courtesy of the Internet. A web page storefront with a detailed list of frequently asked questions plus a downloadable evaluation kit might work out. I think you could also add a script to the web page to collect information for leads.

Consulting can lead to a new derivative. I decided to add this section when I got yet another "are you available to customize?" call from a prospective C-odeScript customer. They're really interested in the product, but have a few oddball (but important to them) feature requests. In the end, they may decide they really don't need the special features, but my readiness to meet their needs seems to leave them with a favorable impression. This consulting service could end up bringing in as much money as the product itself.

CAD to Liana

Way back in 1989 when I finally gave up on an attempt to get financing to develop an architectural CAD product, I was fishing around for a simpler product that I could develop on my own without external funding. Windows was starting to attract a lot of interest and SDK programming was notoriously difficult. My CAD product was going to include an OOP macro language (analogous to AutoLISP in AutoCAD.) The idea was that the entire user interface and upper levels of the CAD product could be done with a lightweight, easy to program, low-performance, macro language while the underlying high-performance CAD engine would be in C/C++. It didn't take me too long to realize that the macro language would make a good product on its own. Although the CAD product was never developed, the structure and key concepts of the stand-alone macro language, called Liana, were certainly derived from the CAD product. So I was able to salvage a lot of my wasted design effort.

Windows NT Port: The similarity of the Windows NT Win32 API to the Windows 3.1 Win16 API made it fairly easy to offer a version of Liana for Windows NT. Although NT still hasn't really taken off yet, this has provided an opportunity for free product promotion.

Macintosh Port: A Macintosh compiler vender has expressed interest in marketing a port of Liana for the Mac. This hasn't happened yet, but is another example of leveraging efforts to produce a new revenue stream.

Enter C-odeScript

Although Liana had very limited success, I recently released a new product, C-odeScript, which is a C- like, object-oriented programming language interpreter which can be called from C/C++ applications. This module was derived

from Liana. A lot of developers liked the Liana language, but felt an obligation to go with C++ or Visual Basic or Smalltalk.

Although C-odeScript is essentially the same language, it is now much more palatable, because the developer does most of their real development work in C++ with their favorite development tools and C-odeScript is merely an add-on library.

Liana was always able to call DLLs so that the developer could use Liana for the GUI and package their C code as a dynamic link library (DLL.) That approach met resistance since turning normal application code into a DLL has a number of technical and management problems. With C-odeScript, the situation is reversed. I provide a DLL which is callable from a C/C++ application. It also has the ability to call back to the application's code. This is a much more palatable and less risky approach for C programmers and their managers.

A modest increment of effort turned one failing product into a more promising product. The market for Liana was limited to developers willing to consider an alternative to C++. In other words, it excluded the C++ market. The market for C-odeScript includes the C++ market. A small difference in technology, but a big difference in potential market size.

What Did I Do?

The underlying language and class library is identical to Liana, with only a few exceptions. Unlike Liana, the GUI features in the class library are a minor, nice plus rather than the key feature. I considered stripping out all the GUI features, but decided that having a compatible library was worth the increased size of the library.

The biggest difference is that C-odeScript doesn't include the interactive development environment or the ability to generate executable files. The other major difference is a documented application programming interface (API) which is how the C/C++ programmer talks to C-odeScript.

Adding the ability to call application functions from C-odeScript was an important addition, but was not a lot of code. Another small effort producing a big benefit.

The result is a product which shares a lot of technology but has a dramatically different appearance to the market. I had considered incorporating Liana or at least L in the name to draw attention to the commonality, but decided that I cared less about people who knew about Liana than about those who wanted a callable scripting language interpreter.

Stripped-down C-odeScript

One early C-odeScript customer is very interested in having it available under UNIX, DOS, and even PDAs. Another is interested in reading binary scripts that the user downloads from an Internet web site — more potential markets.

IDE Toolkit

I have been working with a small Macintosh compiler vender who has a bare compiler but no GUI development environment. They were intrigued by Liana and the idea of a small, easily customized IDE. We signed an agreement and I

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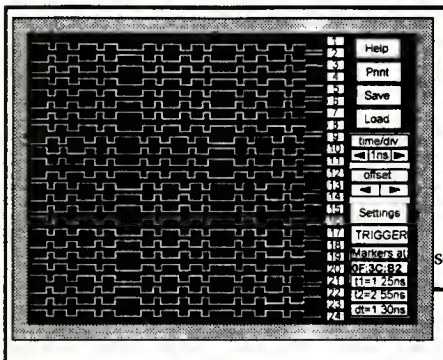

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got some money, but no product has shipped yet. This project was based on work I did for Liana, but now it may take on a life of its own.

GUI for Traditional Tools

That same Mac compiler vender is looking to broaden their product line and likes my idea of a simple IDE that can quickly be attached to an existing non-GUI development tool. We are currently discussing such an effort for a FORTRAN source code manipulation tool. They need to enter lots of parameters and view before and after versions of code side by side. This is not a performance intensive app, so the ease of programming and flexible OOP features of Liana are a real plus. Since it isn't a lot of code (probably no more than a few thousand lines), they aren't worried about being able to hire an army of C/C++ (or VB) grunts to work the code . In fact, the minimal development effort and rapid time to market are the key issues. But probably most important is the fact that they can easily start with my existing IDE instead of beginning an extensive design effort to do their own.

Identifying Derivative Products

One place to look for suggestions about derivative products is your existing customer base. Your product may have had limited success that could be expanded if you corrected limitations that your customers can identify.

Another place to look is those people who never bought your product to begin with. They had some concerns and raised some issues. That might be your blueprint for a new product.

There's no harm in making a few cold calls to venders who might benefit from integrating their products with yours. Serendipity is sometimes your greatest ally.

You've invested a lot of time and money creating your intellectual property, so make them work for you. It's a good idea to have an enduring piece of technology that can survive each time Microsoft comes out with a new release and consumes a larger chunk of the Windows add-on market.

Derivative products are great for serious technology developers who wish to focus on developing innovative technology and leave some of the marketing to others.

They're also great for someone who really knows an application niche but doesn't have the time, patience, or expertise to develop the core technology themselves.

ME

Jack Krupansky runs a one person software business, Base Technology, which develops and markets the Liana object-oriented programming language and C-odeScript callable scripting langnage interpreter and offers Windows software development consulting. He may be reached at 212-626-6630, Fax at 212-626-6632, e-mail at 70642,2662 on CompuServe, or snail-mail at 1120 Avenue of the Americas, Fourth Floor, New York, NY 10036.

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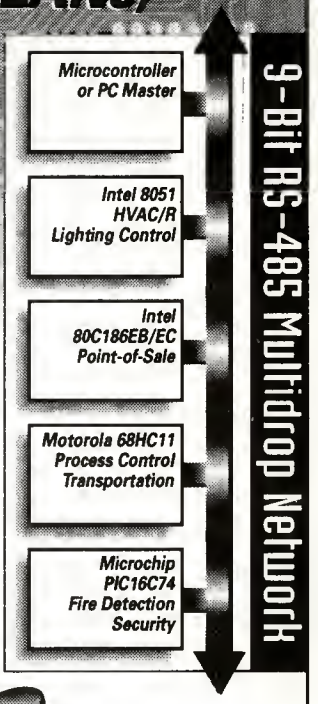
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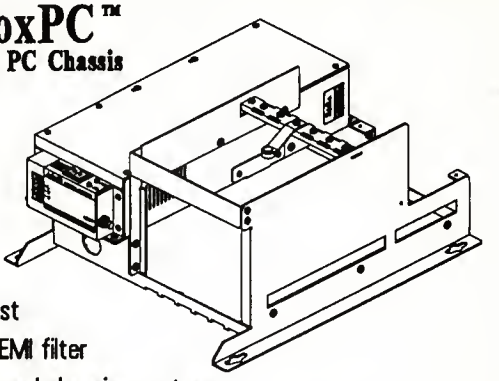

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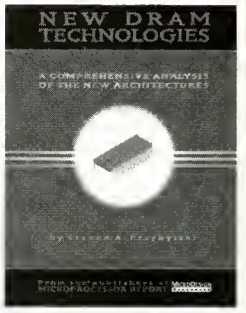

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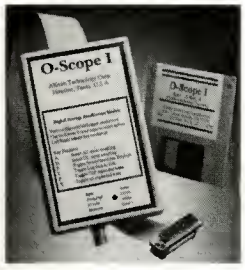

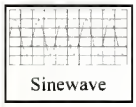
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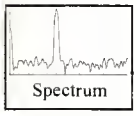
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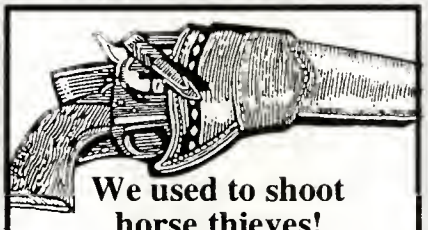

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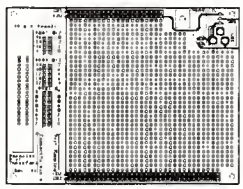

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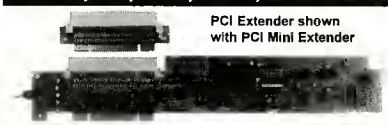

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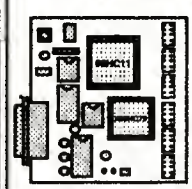

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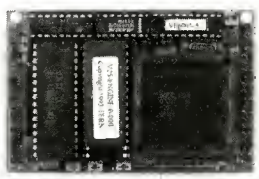

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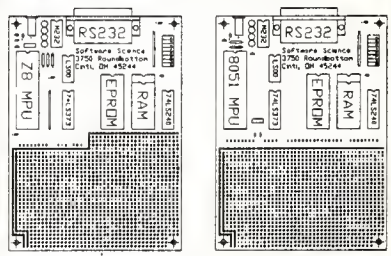

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Reader Service Number 80

The Mount Graham Aerial Tramway

by Don Lancaster

Once upon a time (June of 1923 to be exact), there seemed to be a crying need for sawn lumber in the farming communities of the Gila Valley. There was lots of large Ponderosa Pine and Douglas Fir high up on nearby Mount Graham. Along with an existing steam sawmill. But that was there and this was here.

So close, and yet so far away.

Two earlier attempts at logging flumes lay in shattered ruins. Unworkable because of extreme topography, little water and really bad engineering. A tortuous and deadly wagon toll road priced the boards out of their seemingly nearby markets. Including several "Are we having fun yet?" pleasure spots such as *The Dugway*, *Slick Rock* and *Dead Horse Turn*. Through wild country which *to this day* remains accessible *only* by foot or mule.

So, the decision was made to simply sail the boards up through the air. Frisbee style. An *aerial lumber tramway* was built. Which turned into one of the most astounding engineering feats in all of Southern Arizona.

The Route

The aerial tram began at the Old Columbine mill site at an elevation of 8685 feet. It then headed out straight as an arrow one degree east of true north. First traveling a half mile *up* across a 9045 foot ridge and then dropping to the Shingle Mill Canyon transfer station at 4480 feet and a distance of 4.2 miles.

At the transfer station, the path shifted some 36 degrees easterly. Then traveling another straight-arrow 3.3 miles to the Pima terminal at an elevation of 3241 feet.

A total length of 7.5 miles and an elevation delta of 5804 feet. *Which is well over one vertical mile!*

Wooden Towers

Much of the tram was fairly low tech, cobbed up out of wood and a few key pieces of recycled low grade cast iron. Everything had to be packed in or drug in by mule over wildly inhospitable terrain.

Around ninety towers (the precise number is arguable) were used over the route. The typical tower spacing was around 300 feet. With a maximum single hop span of 1800 feet and an end-to-end drop of 800 feet.

A few of the towers were rather spindly and reached a startling 40 feet in height. But the average tower was just high enough to safely clear the lumber loads.

The typical all-wood tower was a fairly sturdy buttressed A-frame affair which stood a tad under fifteen feet tall. Its sole reinforcement was a pair of iron tie rods. Machine bolts or lag screws and fat washers for the larger timbers; plain old nails for the braces. Most towers rested on small concrete footers which ultimately proved to be too small and way too shallow. A pair of fixed cast iron *track saddles* sat on each end of the tower's top beam.

At shoulder height, one pair of cross-track braces. On these, a pair of along-track wooden rails on each side. The rails supported an off-center sixteen inch *tow wheel idler* spinning inside a cast iron carrier frame. Whose bearings were plain old axle iron on casting iron, helped along with a little grease. Each tower thus had only *two* moving parts.

Fixed "M" shaped guide rods acted as simple pilots for the wheels. A heavier one on the downside; a lighter and longer version on the upside.

You'd see what at first seemed to be five cables at any tower site. One was a simple iron telegraph line that went from tower top center to tower top center along the entire route. And doubling as a broken tower detector.

Track cables went from tower top to tower top, sitting in greased groves in the track saddles. As the name implies, these are more or less stationary cables whose task is to support the hanging tram cars.

Since the heavy traffic all went downhill, the 1-1/4 inch "down" track cable on the eastern side was thicker than the western 1-1/8 inch "up" track. A special tram-optimized flat *lock coil* cable weave was used.

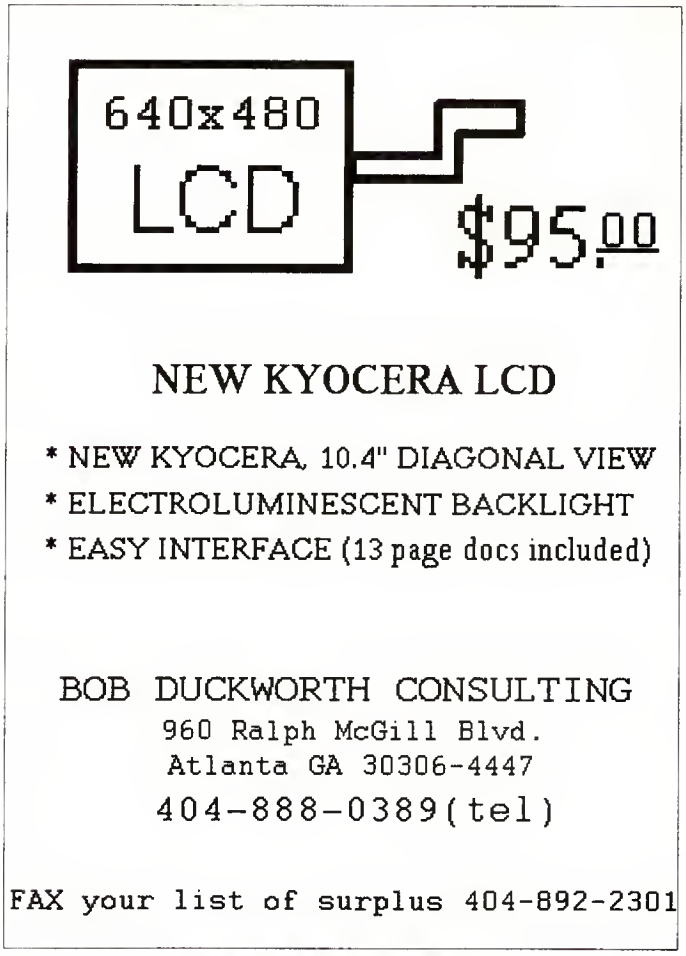
What first appears like a pair of *tow cables* went from tower to tower at eye height. In absence of a car, the tow cable sat on and spun the idler wheels. This was thinner wire rope as its only role was to tow the cars along.

In actuality, the tow cable was continuous on either tram leg. This wound around a horizontal drum at the terminal, went down the route on the east tower sides, wound around a second horizontal drum and a tensioner at the transfer station, and then went back up the same route on the west tower sides. This tow cable was field spliced.

As a car or a pair of cars approached a tower, the tow cable would get hoisted up out of the grooved tow wheel idler. After the cars passed, the cable guide rods would realign the tow cable back down into the idler groove.

The Cars

The cars themselves seemed fairly sophisticated. These were recycled from ore bucket mining duty. Each car was basically a four foot diamond shaped iron frame that had a pair of 10 inch track rolling wheels on the top, a swivel



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mounted and roller-backed automatic gripper in the middle, and a chain sling at the bottom.

Unloaded, each car weighed around 240 pounds.

The cars would roll underslung along the track cables and, when the gripper was closed, got towed by the tow cable. On the down trip, the cars would get used in pairs. One near each end of one dozen boards or half a dozen timbers. The cars would thus typically be six to ten feet apart. Iron guides and channels "squared up" the chain slings to match the load. There was a hidden quick release under each bottom support channel.

On the up trip, the cars usually returned singly. Mostly empty, but sometimes carrying a sack of grain, mail, a bale of hay, or whatever.

The gripper mechanism showed some creative design. There was a rolling ball the size and shape of a trailer hitch which activated an overcenter two-state toggle mechanism. Sort of a mechanical set-reset flip flop. Ball up and the gripper was open; ball down and the gripper grabbed the tow cable. Deflection plates mounted on the stations would automatically release or grab as needed.

These plates would be placed *after* the ends of the track cables but *before* the loop of the tow cable. At activate time, the car would be riding on a set of high rails similar to those in a large meat locker.

The gripper casting seemed to include an obvious bell. Presumably it dinged once on each grab or release.

Tension Stations

Rather than trying to manhandle (and mulehandle) some fifteen miles of cable through country that would make a marine drill sergeant blanch, the track cables were broken up into mile long segments. One end of each cable was secured to a giant eye set in a solid concrete foundation. The cable would then route up and over the top saddles of a dozen or more towers and end at a *tension station*.

Besides allowing shorter cables, the tension stations kept the track lines from sagging under load.

At the tension station, the track cables would go over large pulleys and hang on *floating* concrete weights.

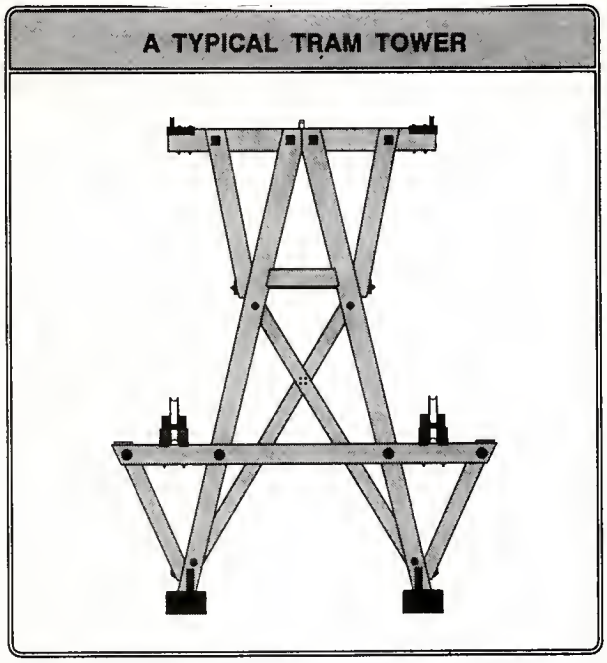
These humongous blocks weighed in from 8000 to 30,000 pounds. Made from iron-reinforced cement poured around groups of locally gathered large rocks. Gneiss, mostly. The weights would ride up and down in massive wood guides reminiscent of a double hung window.

At a tension station, the cars would leave their entry track cable, traverse a short *transition sheave* to a fixed horizontal rail, traverse a second transition sheave, and end up on the exiting track cable. The moving tow cable was oblivious to the bait-and-switch, and simply dragged the cars along. The fixed rail was supported by cast iron "J" skyhooks bolted to upper support timbers.

Three "double" tension stations held two weights and two anchors each. Two "quad" tension stations supported four weights but no anchors. The remaining eight anchors were paired at the upper terminal, the lower terminal, or at either end of the transfer station.

Down track weights were always heavier.

Much of the aerial tram was built from parts recycled from earlier tram and mining ventures. The tension pulleys form a curious mix. Obviously gleaned from a variety of strange sources. In several cases, a rod hoop got welded



onto a mine car wheel to form a cable guide pulley.

As you might guess, 30,000 pound concrete blocks are somewhat vandal resistant. Many survive intact to this day. Even so, at least one of them has gotten hauled off as a tourist memento. In operation, these tension stations must have been extremely impressive.

It is still a stunning adventure to come upon a station unexpectedly in heavy brush. I'm trying to reconstruct their engineering drawings. But exact details of their upper reaches still remains elusive.

The transfer station and the Pima terminal also were long and rather elaborate wooden structures which allowed for intermediate storage and routing of the loaded cars. At the transfer station, the uncoupled cars would get slid along skyhook rails and recoupled to the second leg of the tram route. Human intervention was apparently required. A few tantalizing photos show how big and how complex these stations really were. But they don't reveal much in the way of precise technical details.

Little remains of most of these sites today.

Gravity Powered?

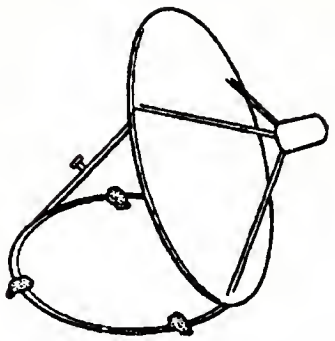
Local lore has the tram running entirely by gravity. And having enough energy left to run the sawmill as well. There was in fact a steam boiler at the sawmill and an engine at the nearby tram terminal. Motive power apparently was coupled to the lower tram leg at the transfer station by a vertical axle and pair of gripper wheels.

Let's see. Take 400 pounds or so of wood and drop them 5000 feet. That is around 2 million foot pounds of work.

Make the trip in, say, 40 minutes.

This gives you something like *three* horsepower's worth of effort. Per load. Because of loading times, I'd think it unlikely that the average loads could be closer than seven minutes apart. Guessing six loads active at any one time yields you something around 18 horsepower derived from gravity. But two of those loads would cancel each other out going over the ridge.

Leaving you with a net 12 horsepower.



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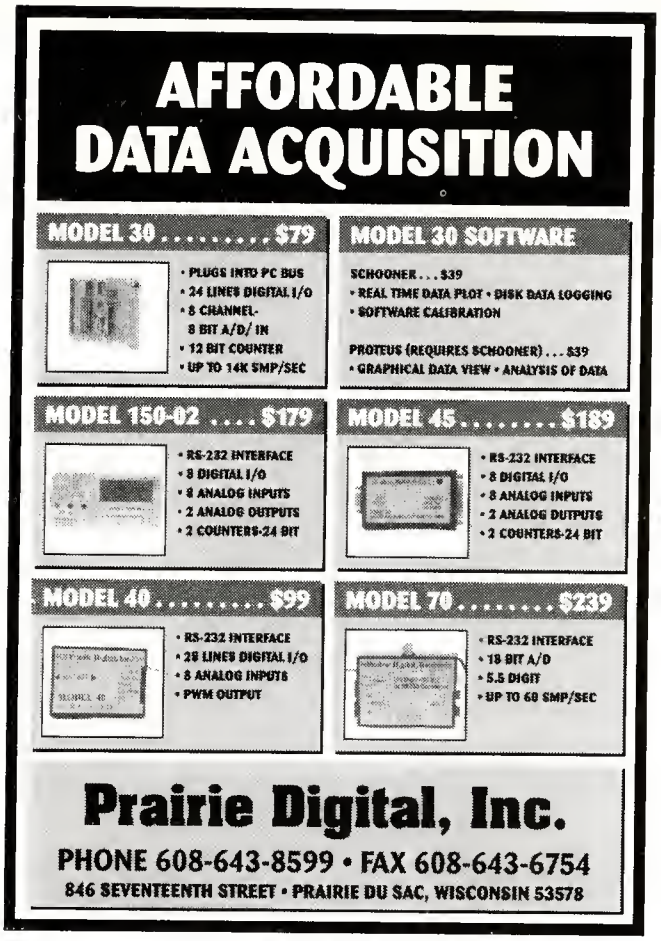
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Those 12 horses had to overcome wind resistance, flex a lot of stiff cable, and spin hundreds of idler wheels.

So we can give some credence to historical statements that the tram "pretty much ran by itself." But *no way* did it saw up any boards in its spare time.

Success and Failure

Judging by the few surviving photos, great heaping loads of lumber got delivered on down to Pima Terminal. Sadly, the aerial tram got shut down and was partially dismantled *one year* after it started operation.

Part of the reason might have been underlying economic problems with the sawmill. Or new Forest Service regs.

But the tram apparently needed continuous repairs and seemed to have had woefully excessive downtime. At least, that's what today's on-ground evidence suggests to me. My guess is that the delivered cost-per-board was too high to make much economic sense.

The system design and construction was all done using local help, because an experienced real tram engineering firm was "too expensive".

There were several gruesome fatalities and a number of other gory accidents. The transfer terminal literally ate an operator for lunch one day. At least one track cable failed spectacularly. Giving a profound new depth of meaning to the term *sprooiinnggg....*

In those days, of course, OSHA inspectors were dealt with simply by hooking them onto the next tram car.

One series of repeated tower failures required at least five rebuilds. Done without any attempt at improving the design or fixing the problem. Other towers were hastily rebuilt or added without proper footings.

Scattered piles of fire bricks in strange places suggest impromptu blacksmithing. Collisions between cars and towers apparently occurred. To the obvious detriment of both. Lost loads and shattered towers still litter some of the more remote canyon bottoms along the route.

I guess the final analysis was that the Mt. Graham aerial tram delivered the boards but not the bucks.

Back to the Future

What does this failed and largely forgotten tech venture have to do with any of today's Midnight Engineering?

I see several key points here...

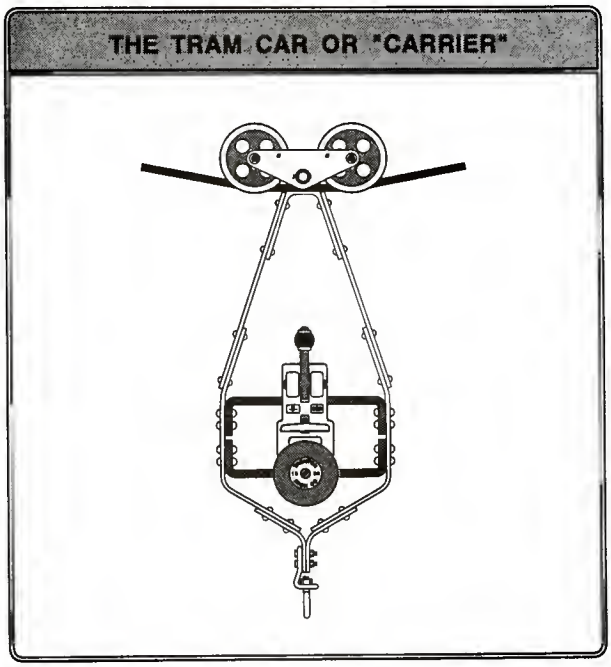
To work hard, you gotta play hard– No matter whether it's hiking, caving, hang gliding, bike, ski, or scuba, you flat out have to get down and dirty.

Study the classics– That's where all the fundamentals of appropriate technology, elegant simplicity, and workable real world results first come down.

It ain't creative unless it sells– No matter how wonderful your design, iffen it don't pay for itself in one manner or another, you have a failure.

Cheapest is rarely the most cost effective– Solid footers, steel, and real bearings outperform wood, rocks, and low grade iron. Every time. Guaranteed.

Budget for maintenance– Design your product from the ground up to be fixable and improvable. Always aim for minimum total life cycle costs.



Much more on these concepts in my *Incredible Secret Money Machine II* and my *Blatant Opportunist* reprints.

For More Info

Your usual starting point on tram research is *Pioneer Town*, the Pima Centennial book published by the *Graham County Historical Society*. Limited but highly useful photo collections exist in the Pima museum or the Safford Ranger District of the Coronado National Forest.

Written family clan histories are a big deal in this area, so there are a lot of private sources. These often can end up a curious mixture of fact and fiction. One or two tramway employees remain in the area and are very much alive.

I could use a little help in relocating two "lost" tension stations. But you'll have to be the type of hiker who brings along your own catclaw. Just in case there is not enough along the route. Naturally, the word *"trail"* is not in your vocabulary. Your 4WD vehicle will, of course, receive a 100% authentic Arizona pinstriping job.

I have uploaded several artsy-craftsy tram sketches as TRAMCAR.PDF and TRAMTOWR.PDF to *GEnie* PSRT. Suitable for framing. Along with custom drawing utilities. Speaking of which, I've managed to wrangle a ten free hour trial deal just for you *Midnight Engineering* folks. ✦

Microcomputer pioneer and guru Don Lancaster is the author of 32 books and countless articles. Don maintains a no-charge technical helpline you'll find at (520) 428-4073, besides offering all his own books, reprints, and various services. Don has a free new catalog crammed full of his latest insider secrets waiting for you. The best calling times are 8-5 weekdays, Mountain Standard Time.

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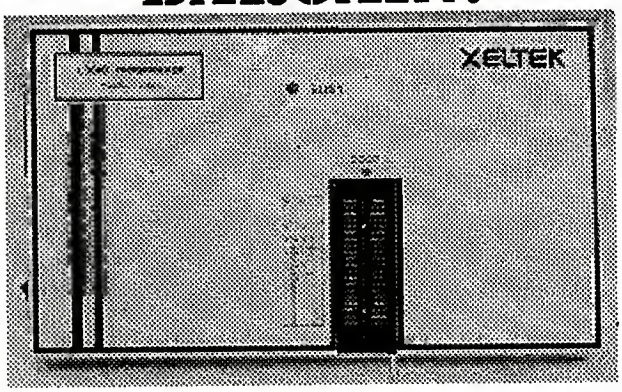

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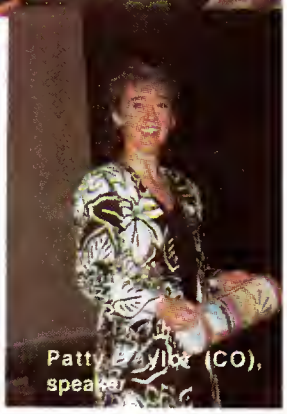
ENTCON 1995

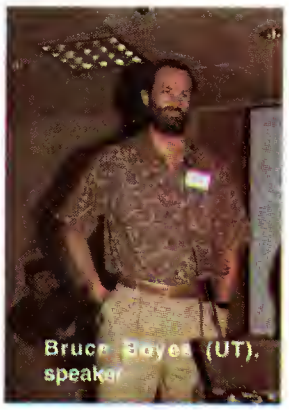
by William E. Gates
Photos by John Gaudio



Special thanks to John Gaudio for shooting these photos of the ENTrepreneurs CONference 1995. In many cases, he risked his neck by skiing backwards ahead of us to get a shot or was seen hanging off the side of the ski lift to take shots of the very people he was riding the lift with.

The people you see here, I will call my friends. They come from all over the world to meet at the Denver Marriott West hotel in Golden, CO. Many of them have come all four years.

Why do they do it? Simply because they enjoy each other's company in an atmosphere designed explicitly for the Entrepreneurial Engineer — straightforward, practical, and fun with no pretense. From the first conference in 1992, I have found only one description that fits: ENTCON is a realtime version of *Midnight Engineering Magazine*. I designed it for Entrepreneurial Engineers like myself who want to take a break, but not necessarily a vacation. We long for the camaraderie of others who are taking a risk, especially if their product or service is high tech. Back home, most of our normal social contacts aren't doing their own business or are not involved in technology.



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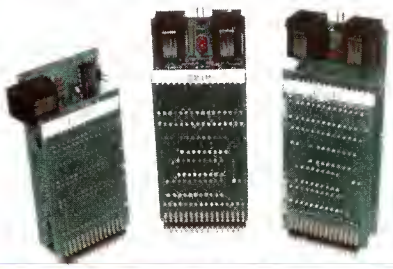

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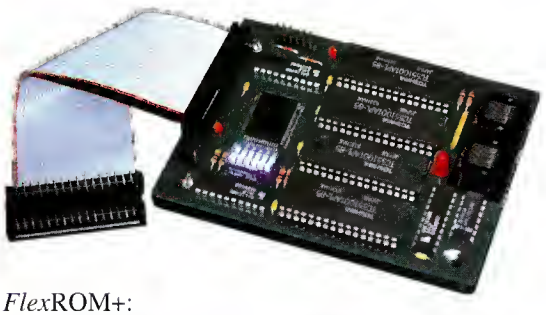

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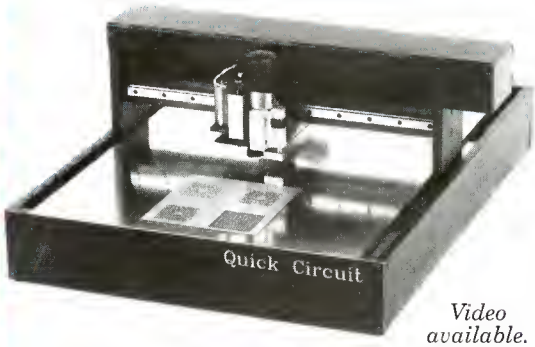

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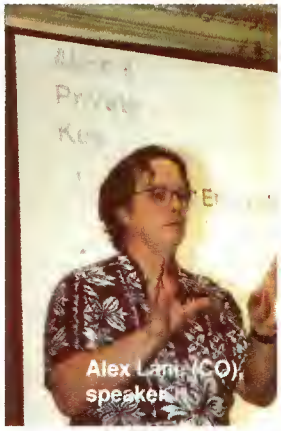
conference and everyone leaves with more than they brought. In many cases it has dramatically changed people's lives, instilling them with confidence and resources that they would not find elsewhere.



In my opening remarks at the formal start of ENTCON 95 on Friday evening, I reminded everyone that the conference started in 1992 because I wanted an excuse to go skiing each year with some entrepreneurial friends. I wanted to talk about technology, product development, small business operations, and all those other things that affect an Entrepreneurial Engineer — like taxes, regulations, employee problems, intellectual property rights, free enterprise, and on and on. I wanted to have fun my way: an upscale atmosphere and an aggressive agenda of skiing and conferencing, punctuated with every excuse I could think of to talk, eat, and drink with some of the most interesting people in the world — Entrepreneurial Engineers.

ENTCON 95 doubled in size of ENTCON 94. I think it can double in size a couple of more times before I will have to redesign the logistics. I haven't put any serious effort into promoting the conference outside of a few ads in ME and a bulletin mailed to those who requested to be on the mailing list and ME subscribers in the Denver area. This follows from my philosophy that almost everything can be built incrementally, without any need for employees or specific economy-of-scale targets. In my world, there is no real need to have thousands of conference attendees. Hundreds is just fine.

There is no conference staff, just like there is no staff working on *Midnight Engineering Magazine*. Who needs them. I just call my friend Mark Fabian at the Denver Marriott West and tell him what I want the hotel to do. Each year I add more complexity, because everything we did the prior year is a no-brainer. Let's see, more hotel rooms, more meeting space, more food and drink. Everything is directed by, and answerable, to me. That doesn't mean that things don't go wrong. The few things that do go awry are usually fixed quite quickly — only rarely do we have to take the time to recall that I'm the guy writing the checks.

I usually arrive for the conference on Wednesday, but this year I arrived on Tuesday to meet and ski a day early with David Love who flew in from South Africa. I also looked forward to seeing Paul Leonardi from Australia for his second ENTCON on Wednesday and Ricardo from the Philippines arrived Saturday morning.

This year I took my oldest son Ryan (15) out of school and brought him to the conference. His only instruction and only obligation was to keep up with the rest of us during the skiing and the conference. He did an excellent job and it did him a world of good. There is no telling what effect that one week will have on the rest of his life, but my bet is that it will end up being pivotal. He talked at length with Roger Gilbertson (Mondo-tronics) about robots and Muscle Wires at the tradeshow on Friday. There is a new sparkle in Ryan's eyes now when he talks about these things — he has seen that there are real people who make and market these products. There's more to it than just an ad in the magazine. Suddenly, his casual interest in my magazine became quite intense. Then, of course, he also got to meet and talk with Charles Ostman. Ryan has known about these guys and their products for years, but suddenly he got to reach out and shake hands with reality. It has me thinking that maybe there's a real need to address the junior entrepreneurs today — Hmmm....

Bruce Eckel (CA), speaker

Jeff Schmoyer (CO), tradeshow

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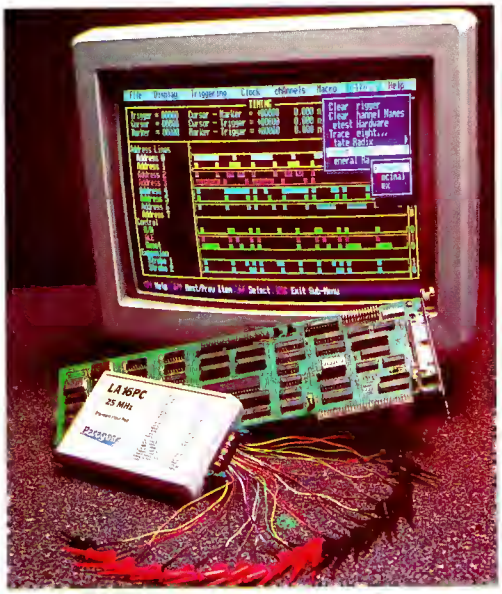

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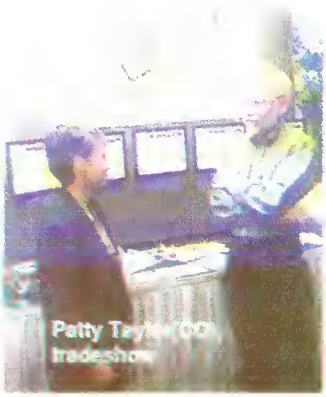
Skiers start arriving Wednesday afternoon and we meet in the hotel lounge most of that evening. I noticed in 1993 that many people were arriving remembering names and faces from the previous year. Now, it seems like we've been doing this for ages — it has that reunion atmosphere.

I purposely split the skiing between Thursday (Breckenridge), Sunday evening (Keystone), and Monday (Arapahoe Basin) to minimize the risk of being snowed out. The Rockies get some fast and heavy snow storms in late March and early April. So far every year, Thursday has been clear and warm with good spring skiing. In '94 we got snowed out on Sunday evening. This year snow started on Saturday afternoon and continued off and on through Monday. None of us went up to ski Sunday evening. But, a small expedition consisting of David Love (South Africa) and Pat Barrett (Portland, OR) was led by Jim Sears (Boulder, CO) and did get some skiing in on Monday, despite the snow.



The conference starts at noon on Friday with a casual tradeshow and goes virtually non-stop until Sunday noon. After my opening remarks at 7pm on Friday evening, Bruce Eckel (C++ expert, author, and worldwide C++ lecturer) is the lead-off speaker. Bruce had airline problems and was

picked up at the airport by Zack Urlocker just in time to arrive and walk into his presentation. Matt Trask (Communica) followed Bruce on Friday evening. The extent to which Matt is willing to share his insight into the ups-and-downs of a growing business is incredible — if you miss his presentation, you miss one of the most valuable parts of the conference.

Saturday is fully packed from the 8am continental breakfast, all day, until around midnight. Saturday morning sessions included Roger Gilbertson of Mondo-tronics (automated business techniques), Jack Krupansky (how he developed deriva-

tive products from his Base Technology product: Liana), and Charles Ostman (nanotechnology update). Buffet luncheon at noon, then on to several shorter and faster paced sessions including Bruce Boyes of Systronix (Building a World Wide Web page), Steve Birrell of Quantum Composers (Fuzzy Logic Techniques), Alex Lane (Encryption), and John Gaudio (Consultant as an Expert).

We break for a couple of hours for small groups to take a speaker to dinner. As usual, Bruce Eckel and Matt Trask are out the door first with their contingent headed for a Thai restaurant on the other side of Denver. I ended escorting nearly 50 people to Baby Doe's restaurant, overlooking the skyline of downtown Denver. The restaurant did an excellent job of seating us in 15 minutes on a busy Saturday evening at rush hour.

I had reserved the entire Saturday evening after dinner for Zack Urlocker from Borland. He filled it very well, indeed. The setting is different for Saturday night, with beer and wine added to the refreshments. Just off of the stiff Delphi development curve, Zack (who writes for *Windows Tech Journal*) had some interesting insights into all phases of product design and development.

Sunday morning Zack returned for a brisk tour of Delphi while most of us were still working on our breakfast rolls and wake-up coffee. For years, at the early TUG and Borland conferences, I enjoyed Zack's delivery and I envy the way he can combine a professional presentation with a casual delivery style.

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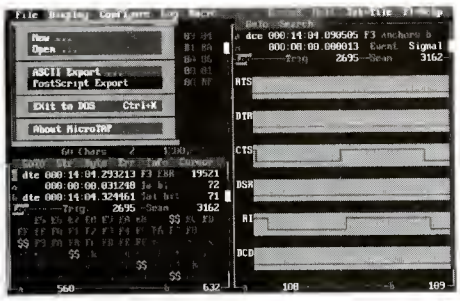

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My presentation on Maximum Productivity concluded the conference. I covered the human degenerative learning curve that starts to decline around age 3 or 4 and why and how fighting that declining curve is a key to really increasing person productivity. I also covered parallel projects, time compression, and overall lifestyle/work integration.

About 50 of us converged on Casa Bonita Restaurant (largest Mexican food restaurant in the world) on Sunday afternoon for a late post-conference lunch.

If you didn't come for ENTCON 1995, plan now for ENTCON 1996 on March 31 - April 2, 1996 in Golden, CO. See you there!

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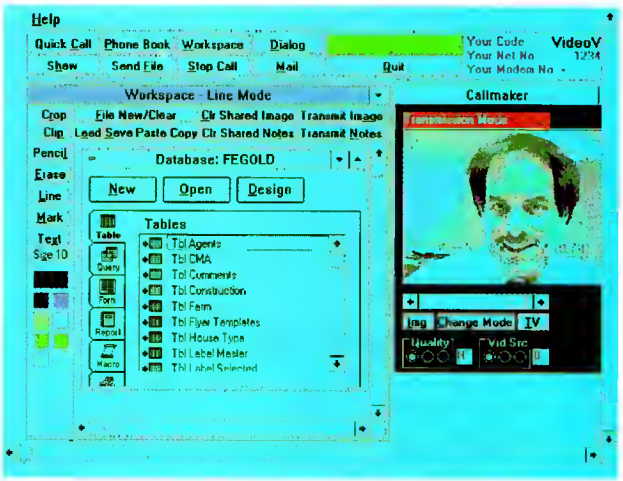

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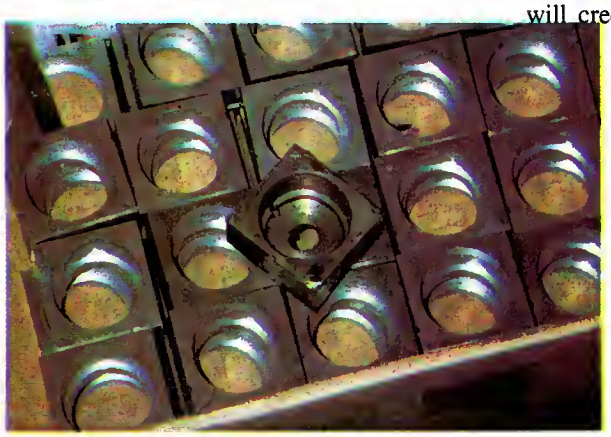
RFPC -- 6

by William E. Gates

Returning from ENTCON 95 in mid April, I was set to make my attempt to print this May/June issue of ME. The problem was that the printing press still had significant functions that were not tested.

Printing black ink only, using press unit #4 had been tested, but there was still a long way to go to print 4-color.



The editorial in this issue addresses the problem with assumptions, but we have to make them. I assumed:

- I could get the new rollers into Unit #1 in a day or so
- I could find 10 rolls of the right paper for this magazine
- I could learn how to make printing plates
- I could print the subscription cards on the small press from Boston
- I could figure out all the functions of the presses in time
- Acts of God would tend to work in my favor
- My assumptions would see no undue increase in their failure rate

As it turned out, I did find sources for paper, but they were marginal. The paper I got was out of New York and had a dull coating instead of a real high gloss. I think the paper shortage is starting to bring all the rotten stock out of the woodwork. I should still be able to print with these 10 rolls, but about 10% of each roll will be wasted due to shipping and handling damage. One of the rolls looks like it fell off the truck — the center core is completely crushed. The paper company says they will credit me for the damage, which will allow me to run this marginal paper for testing. It's easy to chew up $1000 a day in test paper alone.

Printing plates ended up being easy. Here, all my assumptions/hopes worked out. I found an acceptable exposure time and was able to turn out excellent plates for both the small letter size Multilith sheet-fed press from Boston as well as the 25" x 36" plates for

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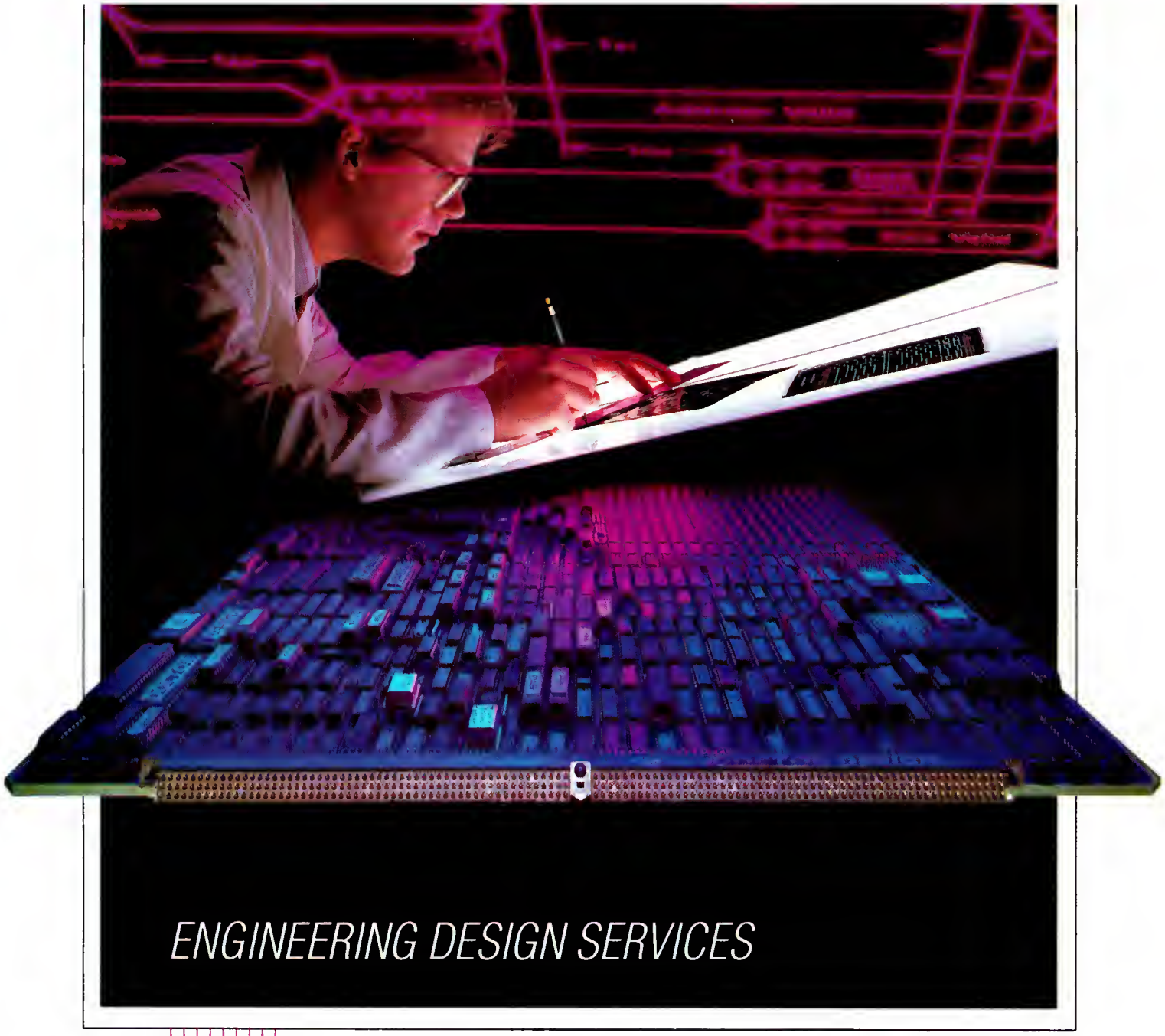

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the web press. To make up these larger plates (especially for the color work) requires multiple exposures with each piece of film positioned perfectly. It was a joy to see this work out so well.

I initially developed the plates by hand, but I have a plate processor that I got for $50 that will speed up the process and make it more consistent. These processors cost about $2000 new, but this one is ten years old and has been sitting out in the rain for over a year. The rollers and pumps look to be in good condition and I don't care what the cabinet looks like from weather exposure. This price differential is very important. I have consistently found this old printing equipment can be made to work and is available for pennies on the dollar. It has allowed me to build an equipment inventory that will be worth hundreds of times what I paid for it.

One Day An Angel Appeared

I think I am finally able to spot Angels. I mean, out of nowhere this guy named Joe walks into my plant in this little town of Rocky Ford, CO. He says he has just moved from Denver and is looking for a job. He has run printing presses for a label printer in Denver for 10 years and all he can find in this area is some roofing work for his brother-in-law.

The big web press he finds intimidating, but he identifies with the little Multilith press that I want to run my subscription cards on. These cards will be bound into the magazine. I won't be hiring anyone, but I offer to pay him $100 just to run my insert cards (about 8 hours of work).

So, he cleans up the little press (it uses the same 100 year-old technology as the web press, but you can get your arms around it like some kind of a toy).

Angels apparently aren't engineers, because this guy didn't understand how the mechanics of even simple mechanisms on the press worked, just that they did this or that. There was something surreal about the whole thing, but I decided to play it through. We used the big cutter from Boston (remember I have two of these now) to cut up the card stock and I made the printing plate for him with the card image on it.

I had made a visit to Dixon Paper in Denver about 6 months ago and literally bought one of everything on their shelf, in terms of printing supplies. Ink, press wash, dampner solution, etc, etc. Joe picked from this assortment of chemicals and accessories what he needed and by the end of the day he had that little press pumping out insert cards. He finished maybe 12,000 cards before he went home for the day, promising to be back the next morning to finish the job. He never came back! Isn't this what Angels do? Don't they stop by just to help you out when you need it the most?

When Joe didn't return after a few days, I started tinkering with the little press. It took me a couple of hours, but I figured out the ink, water, etc and I was able to finish the run of cards, turn the cards over, make a new plate, and run the backside of the card. You'll notice that the inserted card on this issue has a little "Printed by RFPC" on it. And, if you're really lucky, you got one of those few ratty looking cards that I printed just after I realized Joe wasn't coming back.

Readers will, no doubt, remember my quest for cheap 4-color separations

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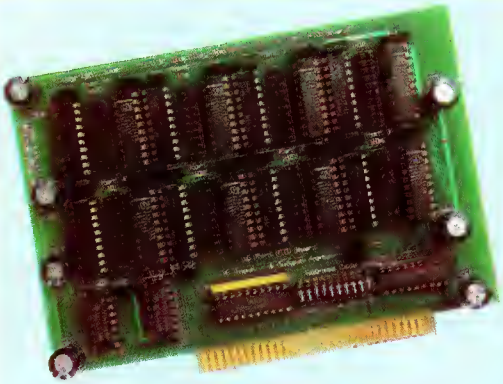

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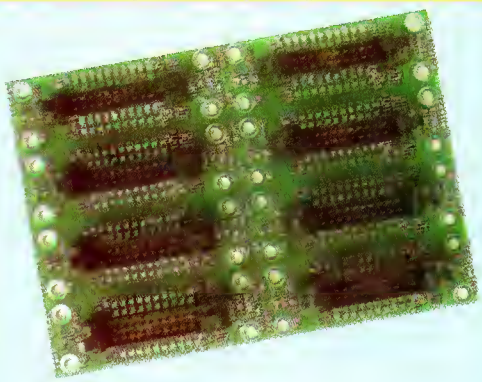

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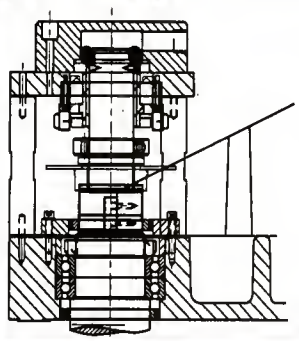

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Reader Service Number 88

that has resulted in a severe testing of reader loyalty due to irrational color for the last year. Well, things are going to get much better soon. Those professional imagesetters (Linotronic) machines that were priced at $100,000 ten years ago were still $50,000 five years ago and $20,000 about 18 months ago. Now they are selling in the used market for about $2500, so I snapped one up.

What you see in this issue is a combination of my Lino and some pages with the technique I was working on. I had ASSUMED that the Lino would work with Corel Draw 5 and Corel Ventura Publisher 5, but in the end I found that both programs would image to film positive, but would bomb out on imaging film negatives. The imagesetters probably are about the most user-unfriendly machines in existense — all you get is cryptic codes on the Lino front panel. Of course, Corel Technical Support had never heard of such a thing. But, I found that Ventura 4.2 would output to my Lino with negative film, so that's what I used to lay out this issue.

By the first week of May, I knew that everything was not coming together, but I pressed onward anyway (pun intended). I could not find the little 2" square bearing blocks to mount the rollers in unit #1. Within a few days, the local machine shop bored out 50 of these little guys and instead of a day spent mounting these new rollers in press #1, it took over a week. But, now I had all four printing units under power.

At this point, I thought that maybe I could still print this issue. I made the plates for section 3 of this issue (only uses black ink, no color). Running the last of my original test roll of uncoated paper, I got the feel of the ink and water controls, the registration and folder alignment, and the test of crude oven heaters (more on these next issue).

I was getting such good results that I called my father again and got him to fly in from California to help me run the first issue. That's when things really started to come unglued. The very night he arrived it started to rain. This shouldn't have been a problem. I had had a few roof leaks, but suddenly it was raining more inside over my press than it was outside. There were a dozen significant leaks right over the folder and other places in the paper path. To make matters worse, the standing water on the floor was raising the humidity to the point that I was beginning to worry about my $10,000 worth of paper rolls. When we finally did get the coated paper on the press, we discovered that it would not stay straight. We needed a paper steering box (4 rollers in a specific arrangement) that would have to be built.

This was the final nail in the coffin. I had to abandon the idea of printing this issue myself and return to the printing company in Denver. But, they had their own problems getting paper. Three truckloads of paper had been cancelled by their distributor and prices were still rising. They did find enough to run my job and get this issue out.

My father is sticking around and we'll do some 4-color test printing as soon as I get this issue in the mail.

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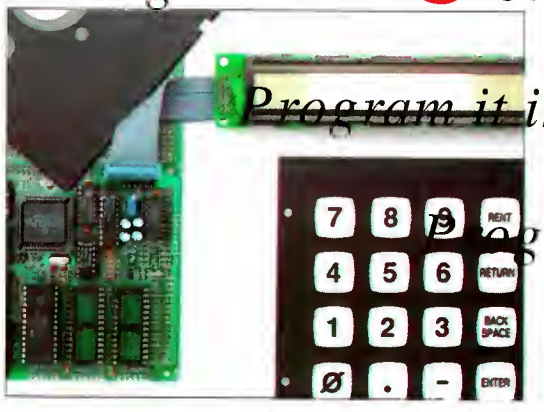

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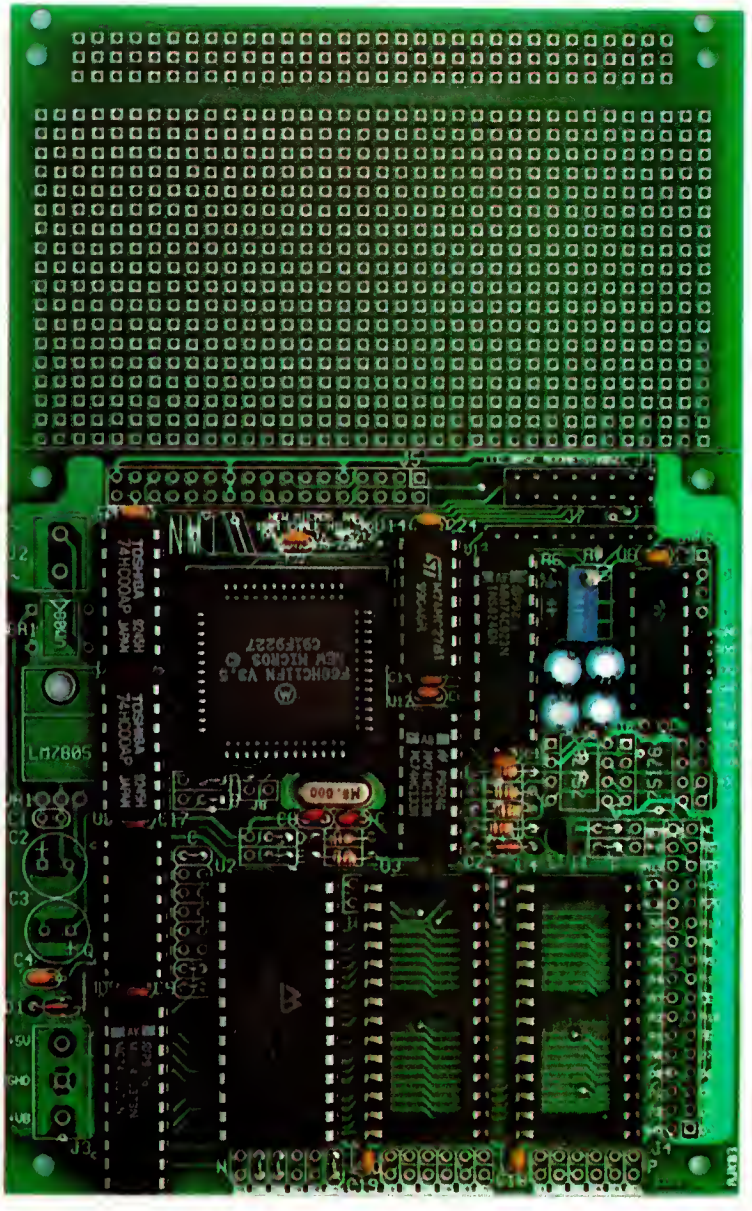

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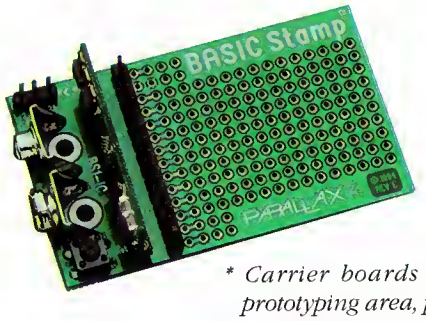

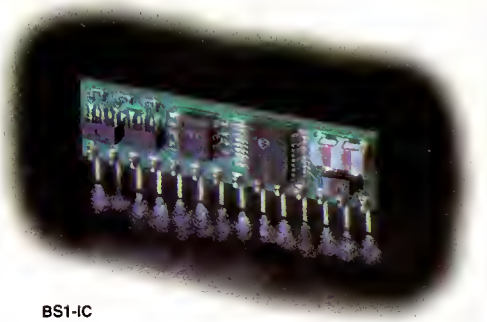

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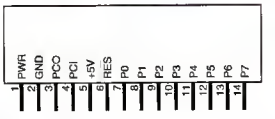
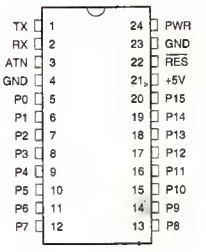
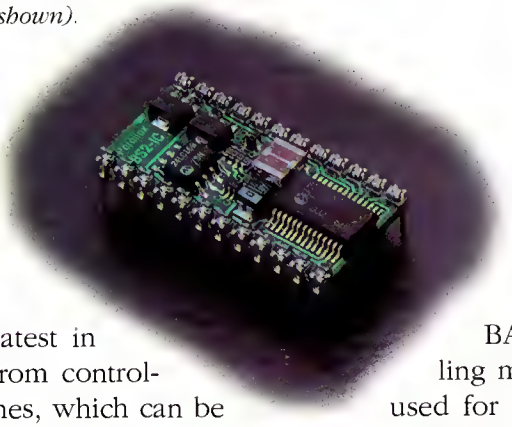


** Carrier boards provide battery clips, prototyping area, programming connector, and reset button (BS1-IC carrier shown).*

BS2-IC





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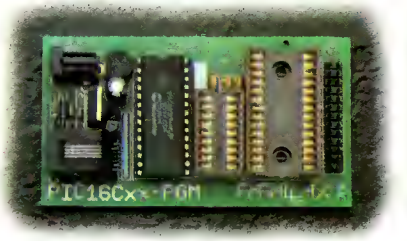

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